ANUMUKTI

A Journal Devoted to Non-Nuclear India

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An Appeal to Conscience

ecently there has been a spate of reports in our media regarding the starting of the Kakrapar Atomic Power Plant. We have cause to suspect that the plant is being started without the authorities taking the minimum precautionary steps needed to ensure the safety of the people living in its neighbourhood. The note written by Shri K. Natarajan, the head of instrumentation and control at Kakrapar power plant which was published in the *Sunday Observer* of 26.7. '92 by Ms Rupa Chinai *in* her article on safety violations at the Kakrapar plant, proves that the authorities in their hurry to start the plant have disregarded their own safety norms. These violations of safety procedures are a dangerous game with the lives of the people in the vicinity at stake. We pray to God it doesn't, but in ease there is an accident at the plant, and the untested safety systems fail to perform their function, the consequences would be disusterous. Keeping the public in the dark regarding it's own safety is a step toward unbridled dictatorship. The fact that these dangerous actions are being undertaken due to considerations of personal gain make them akin to treason.

As a concerned citizen living near the Kakrapar plant, this total disregard for the safety and well-being of the nearby public, is intolerable to me. Therefore, I have decided to undertake a five day fast commencing from the 11th ef September, 1992. The purpose of the fast is threefold. It is firstly, to express my concern, secondly to demand an enquiry to establish the facts and thirdly to request the authorities to refrain from opening the plant till it satisfies all the safety norms established by the nuclear authorities themselves, This fast is not being undertaken against any particular person but rather in a spirit of humility as a prayer to God to grant wisdom to all and also as a citizen's protest against this blind system which is hurtling us all towards extinction.

I have for long been an opponent of the policy of nuclearisation of

the country and I feel that the entire nuclear programme ought to be stopped. forthwith. However, that aim would be achieved only when the power of the entire population rises against this suicidal system. The purpose of my mat is more limited. It is a cry against the total abdication of responsible behaviour by public servants.

Unit 1 of the Kakrapar Atomic Power Plant went critical on the 3rd of September, 1992. In the old days, Prime Ministers used to cesne tor these ceremonies and 'dedicate the plant to the nation'', but nowadays, Prime Ministers are too busy protecting their throne to have much time for these mundane events. So, the task is performed by the Chairman, Department of Atomic Energy. This worthy is however, considered too small a fry to dedicate anything to anything. Hence he merely declared the plant critical. Also, critical were hundreds of workers in the audience, who wore black armbands as a protest against the fact that their demands had not been granted. Six tonnes of sweets (Pedha) had been specially ordered from Baroda for the occasion. Being a persona-non-grata with the plant authorities, I had not been invited for the grand occasion. Otherwise, I would have certainly advised the local people to have their fill of the pedhas, since this would be the last occasion for the next many millenna that they could enjoy a

milk product without worrying about the threat of radioactive contamination.

Narayan Desai

Response to the fast

The response to the fast has been overwhelming. People from all over India have responded in their own fashion. Some have fasted for the whole five days while others have gone on a one day sympathetic fast at Udaipur, Ahmedabad, Surat, Vedchhi, Valod, Bedkuvadur, Ghasiamedha and Mangrol. In Vedchhi itself, 250 people fasted for one day. Daily discussions were held at The Sampoorna Kranti Vedchhi. **Street plays were performed daily in different villages. The villagers in the vicinity of the Kakrapar atomic power plant have decided to organise people's vigilance committees. Involvement of the youth has been overwhelming. They "are concieving ways to educate the public on this issue. A large procession followed by a meeting was held at Valod on the 15th where a resolution was passed to demand foran independent inquiry.**

***Anumukti is late. You** now **read the** announcement of the fast **and** the opening of RAPP, followed by the report and reponse to the fast.*

NOTICE BOARD

JP Memorial Lectures

Date: October 8th. and 9th.

Venue: Sumpoorna Kranti Vidyalaya, Vedchhi, Dist. Surat 394641

Speaker: A. Mohan Kumar, a well known environmentalist from Kerala who had taken part in the Silent Valley movement and was co-ordinator for Save the Western Ghats March in Kerala.

Subject: Development-'Kerala model" • Myth and Reality.

The lectures will be accompanied by a slide show and will be conducted in Hindi.

All are invited.

Workshop on "Environmental Health Surveys'[1]

A workshop will be conducted at Sampoorna Kranti Vidyalaya, Vedchhi on various aspects associated with epidemeological survey in the vicinity of a Nuclear Power Plant. The Rawatbhata health report will be discussed in detail. Problems, requirements and resources available for conducting epidemeological surveys also would be discussed.

Date: 26th to 28th of December 1992

All interested people should write to Sanghamitra before the end of October 1992.

All Gujarat Cycle Yatra

Anumukti and Gujarat Sarvodaya Mandal are organising a cycle yatra covering ten districts of Gujarat It's purpose is to focus attention on aspects of sustainable development and peoples rights. Special focus will be on the problems of big dams, nuclear power plants, multinational corporations, and suppression of forest rights.

The one month Yatra is scheduled for March end. We need your suggestions and support in organising the details. Contact Anumukti

Editorial

The opening of Kakrapar on September 3, 1992 by the Chairman of Atomic Energy Commission with a fanfare should have been the saddest day in our whole lives. And it was to some, extent. But it was also a beginning of the end for the nuclear industry. *The* hurry in which Unit 1 of KAPP was forced into criticality without even adhering to their own safety norms shows the desperate plight of The Nuclear Power Corporation to attract public funding. An 85% cut in its budgetary requirements by the Centre, and the with the Nuclear Power Corporation's longer than the usual time to finish any project before KAPP, has precipitated severe cost overruns. Flouting basic safety norms at KAPP was an index of a desperate effort for survival.

The financial situation has become so grave that the Chief of the Atomic Energy Establishment, Dr. P.K. Iyengar has been quoted in Nucleonics Week • April 1992 (a nuclear industry journal) asking for foreign funding as well. He says, "In view of DAE's longer term funding needs, India would also consider strengthening its nuclear programme through future capital injections from outside institutions such as the World Bank, other international development agencies and banks. India would have no reservations about using foreign capital to finance nuclear projects built with the assistance of Western Industry."

This is a tacit admission that the Indian nuclear industry's boast of being indigenous and self-sufficient is truly hollow.

With the recent BARC revelations by the media, it is trapped in its own fundamental contradictions. We should soon be fed with a diet of systematic disinformation. We need to be vigilent.

BARC Spews Radioactive Poison

* Disaster of significant magnitude
* Effluents may have leaked into Arabian Sea
* Likely contamination of fish

A major radioactive leakage from ill-mantained pipelines in the vicinity of the CIRUS and Dhruva reactor complex at the Bhabha Atomic Research Centre, 15 km. from the heart of Bombay, is found to have caused severe soil contamination. Evidence also points to the possibility of the leakage having taken place for a number of years, thereby causing an outflow of contamination towards the sea.

According to independent experts, the incident is a disaster of significant magnitude.

The presence of cesium-137 (Cs-137) in the analysis of soil and water around the leakage site means that a most dangerous radioactive isotope is being released in an open area outside the reactor complex, a situation unacceptable under any internationally accepted norm.

The high readings of Cs-137 in the soil area between the reactor and the sea also points to its uncontrolled outflow towards the sea, where it is likely to have been absorbed by marine life. Cs- 137 entering the food chain can have severe repercussions on human beings as it is absorbed by the cells of the body. It remains radioactive for hundreds of years.

The leakage was first detected by reactor workers on December 13,1991, when a fountain of water shot out onto the lawn between the reactor and the sea. The plant management surmised that the sea- water pipeline must have, burst, even though the entire area is criss-crossed with many other lines, carrying radioactive and chemical effluents. The establishment set six contract labourers on the task of digging a pit, to reach the burst pipeline, eight feet below the surface. These workers wore no protective gear or radiation monitoring badges.

The presence of radioactivity in the area may never have come to light had it not been for an alert official in the office of the Radiation Health Inspectorate at the complex, who got wind of the incident and sent for a water sample from the puddle in the excavated pit. The activity recorded in the water sample was 40 becquerel/ml. (becquerel is a unit of radioactivity).

The contract labourers who had worked for almost eight hours inside the pit on December 13 and 14, 1991, were thereafter hastily pulled out, given a bath, new sets of clothing and packed off home. There is no evidence of the labourers having been subject to radiation monitoring tests.

However, the authorities sought to deduce the dosage the labourers had received. On December 19, department personnel dug a small portion from the bottom of the excavated pit. During a 12- minute period, the whole body dose recorded by the DRD (a radiation monitoring badge) ranged from 10 to 30 millirems (mR). Extrapolating on this observation, the radiation exposure of the contract labourers is held to be in the range of 300 to 1,000 mR. (A normal chest X-ray gives a dose of 70 to 150 mR. This would *a*mount to the labourer receiving 12 X-rays during the course of work.)

Tests done in the excavated pit showed a radiation dosage ranging from 200 to 700 mR/hour, while in one specific spot, described as the "Hot Spot area below the chamber" (inspection chamber along the pipeline), it zoomed to 2,000 mR/hour.

Recording of the "soil specific activity level" revealed the presence of Cs-137. In 50 percent of the samples, Cs-137 activity was 1-10 k Bq/gm, and in another 50 percent of samples it was 10- 60 k Bq/gm. Samples of vegetation in the area also revealed contamination, and birds and insects in this area are its carriers into a wider area.

Meanwhile, 325 drums of contaminated soil has already been sent to the Waste Management Deportment. The department has said that the solid active storage would get exhausted if the entire quantity of contaminoted soil is to be excavated, and has stopped further consignments.

On the magnitude of radioactivity present in the soil area at CIRUS, independent, authoritative sources said they were "chilled" by these figures. They compared these to the "acceptable limits" set by the nuclear establishment itself. An advertisement of the Nuclear Power Corporation in The Times of India (July 8, 1990) gives figures of natural background radiation as around 100 mR per year, and compares it to "acceptable" radiation within a 1.6 km. radius of a nuclear plant: 1 to 2 mR per year. The outer limit for dosage to occupational worker is 5,000 mR per year, and for the members of the public it is 100 mR per year.

Taking the lower figure of activity found in the CIRUS pit, 300 mR/hr, it means that persons spending a year in this area are subject to 2.6 million mR during that span, the experts said

According to publications authored by BARC scientists, the "acceptable limit" for Cs-137 is 0.13 Bq/ml. in sea water. In the UK, the permissible limit of Cs-137 in soil is 900 Bq/kg (or 0 9 Bq/gm). Taking the average activity figures found in the CIRUS drums, around 27 k Bq/gm, it means that the activity is 30,000 times higher

than permissible limits in the UK, the experts added.

Circumstantial evidence at CIRUS points to discharge of Cs-137 into the Arabian Sea, where despite the impact of dilution, the chances of it being imbibed by marine life are real.

What was the source of such widespread contamination? The radioactive wastes came from the Rod Cutting Building, where all uranium and plutonium fuel used in the reactor is stored for years in large pools of water, to allow decay and cooling of radioactivity before further treatment. To maintain purity, the storage pool is periodically washed with acid, and the effluents are dangerously radioactive. This discharge is piped to the waste treatment facility in a planned manner, and should never be allowed into the sea, atmosphere or land.

Yet, unbelievably, the pipeline carrying this deadly waste, also at other times, acted as a storm water outlet. The system envisaged that by closing valves, the active discharge would be diverted to waste management, but in reality, for whatever reason, the untreated wastes flowed towards the sea.

The damage to the Concrete Inspection Chamber along the pipeline, where the highest activity is found, as also the sea water outfall pipe (made of half-inch thick steel and lined by two-inch thick RCC) which crosses the ceramic pipe, is evidence of the slow, corrosive force at work.

Worse still, the plant management was aware of leakage occurring in this same pipe, at the same spot, in 1978, but did nothing. At that time, during the construction of the Dhruva septic tank, several hundred metres away towards the sea, Cs-137 was found in the soil. The sample analysis read 20 Bq/ml. The source of leakage was traced to this same pipeline and inspection chamber. Apart from isolating the pipeline and inspection chamber for a while, no attempt was made to replace the decaying pipeline. The report was filled and forgotten, sources alleged.

On January 13, 1992, the BARC and Radiological Safety Committee clearly stipulated three conditions before CIRUS received permission from the Safety Review Committee for Operating Plants (SARCOP) to resume operations. These conditions included ensuring repair and integrity of all liquid effluent lines and assessment and plans for disposal of the contamination. Defying this, and without fulfilling these conditions, the plant management resumed operation on February 6, 1992. SARCOP confirms that its permission was given only on April 1,1992.

When contacted, SARCOP ignored written questions submitted by this correspondent and rejected the request for an interview. It however gave a written response outlining the remedial measures taken in removing the contamination and investigating the incident. It stated that there was no reported leakage on this line previously. It said the contaminated soil has been properly immobilised.
RUPACH1NAI
SUNDAY OBSERVER,
Sept.6,1992:

Radioactive Fountain in the Gamma Garden!

This extrapolated 'casual' labourers' dose is a fine example of the nucleocratic callousness. Any leak involving liquids in a place criss-crossed by various pipes carrying radioactive effluents has to be treated with due care. Safety culture would mean that one presumes the worst and goes into the area well protected. Instead, what we have is that the all knowing big shots decide through visual inspection that the leak is that of plain sea-water only and rush in contract labourers with no protective gear or warning to these hapless fellow-humans. And when through luck these big shots do get a warning, their first priority is not towards the health of their fellow-beings who are quickly packed off with a shower and some new clothes but no continued health monitoring. They are more concerned about saving their own necks by showing that the disaster is no disaster at all. Notice the procedure of estimating the dose received by the casual workers. Five days after the event, departmental workers are sent in with full protective gear and measuring devices. Naturally, they go to the least radioactive part of these mess, stay there a few minutes and then come back. The variation in radiation they received in this short time is taken to be the upper and lower bound for the radiation received by the casual workers who, it is assumed worked for six hours while, actually records show that they did work for more than eight hours, This is the only way we get to the figure of a maximum dose of 1,000 mR. (12 minutes gives a dose of 10 to 30 mR, therefore 1 hour gives a dose of 50 to 150 mR and 6 hours work would give a dose from 300 mR to 900 mR.) The extra 100 mR is a small mercy from nucleocrats. But read the next line. "Tests done in the excavation pit showed radiation dose ranging from 200 to 700 mR/hour. " Now the excavation of this very pit was done by the casual workers. Thus, chances are that these fellows received anywhere from 1,600 to 5,600 mR of radiation while earning their 'new' set of clothes. And this assumes that none of the workers went anywhere very close to the 'hot-spot' in which case his dose would'zoom' towards doom.

Casual workers are members of the 'general' public. The most likely dose received by the unfortunate workers is way beyond internationally accepted radiation safety standards to which our nucleocrats pay ritual obeisance. And hence we find a funny interpretation of the status of the casual workers. According to Mr. Soman, the Chairman of the Atomic Energy Regulatory Board, and supposedly the public's protector in all matters radioactive, "Casual workers cannot be differentiated from the regular workers in the amount of radiation they received." They can and are ofcourse differentiated in the amount of pay, working conditions, facilities, security of tenure, monitoring, etc. *Editor*

EAST AND WEST ON NUCLEAR POWER

Leaders of two nations - one being the epitome of material well-being while the other literally represents a nation in exile • have commented on nuclear power. One would expect the people of Tibet who are struggling to regain their rights to clamour for nuclear power, while the U.S. having become materially well-off would now strive for spiritual development. This is what their Leaders have to say:

GEORGE BUSH

On June 18, 1992, President George Bush held a brief press conference outside an oil recycling firm in California. The press conference focussed on energy and environmental issues. At one point, the President was asked, ..if reelected, what incentives would you devise to aid our country in reducing our overconsumption of energy resources?

President Bush's answer, in full:

"We've got an energy bill before the Congress right now that does that. Encourages alternative use of fuels. We have sound environmental practice on off shore. We 've got in this bill—I mean, from lightning..light..kinds of lightbulbs that really save enormous amount of energy, to alternative uses of fuel, we've got a good program. It's hung up in the US Congress right now. But I would press forward on that energy bill and try to move forward.

Let me say this as a word of caution, though. We are more and more dependent on foreign oil. And it was about a year and half ago, when the Persian Gulf situation got fired up, that it was predicted oil would go to $80 a barrel overseas. And I don't know if you saw what Saddam Hussein said the other day. He said the biggest mistake he made is, when he first moved into Kuwait, that he didn't move into Saudi Arabia. And you want to project something that would just shoot these gasoline prices right off the scoreboard, try that one on

"So what we've got to do, it seems to me, is to try to become less dependent on foreign oil, for security reasons, and that means alternate sources. I may get into a big fight here, but I believe that safe nuclear power can be used safely. It's clean burning, I believe, clean, and I believe that we ought to facilitate that rather than turn our back on that. But it does concern me that we're becoming more dependent on foreign oil, and yet I think the answer is conservation and alternative sources. And that's in our energy bill.".

(We just thought you'd like to know. Perhaps President Bush might benefit from learning that nuclear power cannot possibly contribute to reducing U.S. oil dependency when foreign oil accounts for only about 1% of *VS.* electricity, and even that oil is residue from other uses. On. the other hand, the President might benefit from a few sessions with an English teacher as well... From Nuclear Monitor)

THE DALAI LAMA

In this century, civilization has rapidly advanced. However, along with material development and undue emphasis has been made on externa) progress. Without even knowing it, we often neglect to foster the most basic human need for kindness, love, co-operation and caring. Yet, the very development of human society takes place on the basis of this foundation. If we lose our foundation, our essential humanity, what point is there in pursuing material improvement alone?

Everyone desires happiness and no one wants suffering. All of us also have equal rights to avoid suffering and pursue happiness. Therefore, in pursuing any human activity it is of the utmost importance to bear this in mind. The question to ask is: is this activity beneficial to us? Here, it is important to think not only of the temporary benefits but also of the long term consequences. Similarly, in the case of exploitation of uranium we must ask the same question.

In their eagerness to create nuclear weapons and then to exploit the potential resources of nuclear energy, scientists and politicians have underestimated or overlooked the long-term harmful effects both to mankind and to the environment. What is required to counter this is the development of a proper sense of responsibility based on compassion for our fellow human beings.

With regard to the effects of uranium, we are not only concerned with the rights of the many defenseless people living in various parts of the world but also of future generations. I feel strongly that the cause of peace in the world is inseparable from our ability and willingness to protect the rights of others.

From Message sent to the World Uranium Hearing held at Salzburg, Austria on September 13 -18,1992.

AN APPEAL FROM ANUMUKTI

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Bomb Tests and Earthquakes

"Nuclear bomb testing **has** doubled the **earthquake rate."**
Garry Whiteford, Professor of Geography, University of New Brunswick

"Abnormal meteorological phenomena, earthquakes and fluctuations of the earth's axis are related in a direct cause and effect to testing of nuclear devices."
Shigeyoshi Matsumae, President Tokai University Yoshio Kato,
Department of Aerospace Science.

On June 19, 1992, the United States conducted an underground nuclear bomb test in Nevada. Another test **was** conducted only four days afterwards. Three days later, a series of strong earthquakes one as high as 7.6 on the Richter scale rocked the Mojave desert 176 miles to the south. They were the biggest earthquakes to hit California this century. Only 22 hours later, an "unrelated" earthquake of 5.6 struck less than 20 miles from the Nevada test site itself. It **was** the biggest earthquake ever recorded near the test site and caused one million dollars of damage to buildings in an area designated for permanent disposal of highly radioactive nuclear wastes only fifteen miles from the epicenter of the earthquake. Although the quake provoked renewed calls for a halt to plans for storing radioactive materials in such an unstable area, the larger questions have still not been raised in the United States: Do bomb tests actually cause earthquakes? Do nuclear tests make the planet more prone to geologic disruption?

Understandable Unease

The latest (and apparently continuing) earthquakes in California and Nevada suggest an inquiry by US scientists may be long overdue, and could lead to an examination of studies over the past twenty years from scientists in Britain, Germany, Japan and Canada, warning that nuclear tests **are** weakening the earth's crust, triggering earthquakes and causing the earth's pole to shift.

In a statement on July 14,1992, responding to "understandable unease", the Department of Energy in Washington **asserted** the relationship between nuclear testing and earthquakes is "nonexistent". Yet common sense would suggest the cumulative effect of so may nuclear tests around the world would leave the planet at least somewhat shaken. Indeed in 1956, Estes Kefauver, then Democratic Vice-Presidential candidate, warned, "H.bomb tests could knock the earth 16 degrees off its axis!" He was simply ignored.

However, in a study 20 years later by two Japanese scientists, entitled Recent Phenomena on Earth and Atomic Power Tests, Shigeysoshi Matsumae, President of Tokai University, and Yoshio Kato, Head of the University's Department of Aerospace Science concluded: Abnormal meteorological phenomena, earthquakes and fluctuations of the earth's axis are related in a direct cause-and-effect to testing of nuclear devices...Nuclear testing is the cause of abnormal polar motion of the earth. By applying the dates of nuclear tests with a force of more than 150 kilotons, we found it obvious that the position of the pole slid radically at the time of the nuclear explosion... Some of the sudden changes measured up to one meter in distance.

Not quite Kefauver's 16 degrees off the axis; but not entirely reassuring either. Two years later, on 12 October 1978, the British science journal *New Scientist* reported: Geophysicists in Germany and England believe the 1978 earthquake in Tabas, Iran, in which at least 25,000 people were killed, may have been triggered by an underground nuclear explosion.. British seismologists believe the Tabas earthquake implies a nuclear test that has gone awry. Moreover, a seismic laboratory in Uppsala, Sweden, recorded a Soviet nuclear test of unusual size ten megatons at Semipalitinsk, only thirty-six hours before. One German scientist specifically implicated this test in the origin of Tabas disaster.

More recently, in April, 1989, at the Second Annual Conference on the United Nations and World Peace in Seattle, Washington, Gary T. Whiteford, Professor of Geography at the University of New Brunswick in Canada, presented the most exhaustive study yet of the correlation between nuclear testing and earthquakes. In a paper entitled Earthquakes and Nuclear Testing: Dangerous Patterns and Trends, Whiteford presented alarming conclusions which to this day have remained almost completely ignored in the US, although the paper has been widely translated and published abroad.

Whiteford studied all earthquakes this century of more than 5.8 on the Richter scale. "Below that intensity," he explained, "some earthquakes would have passed unrecorded in the earlier part of the century when measuring devices were less sensitive and less ubiquitous. But for bigger quakes the records are detailed and complete for the entire planet." So Whiteford was able to make a simple comparison of the earthquake rate in the first half of the century, before nuclear testing, and the rate for 1950 to 1988. In the 50 years before testing, large earthquakes of more than 5.8 occurred at an average rate of 68 per year. With the advent of testing the rate rote "suddenly and dramatically" to an average of 127 a year. The

6.1

earthquake rate has almost doubled. To this day the US military attributes the increase to "coincidence". As Whiteford says, "The geographical patterns in the data, with a clustering of earthquakes in specific regions matched to specific test dates and sites do not support the easy and comforting explanation of 'pure coincidence'. It is a dangerous coincidence."

Within the data he found other suggestive patterns. The one-two nuclear test punch that preceded by only a few days the July earthquakes in California this year may reveal a special danger. The largest earthquake this century took place in Tagshan in North-East China on July 27,1976. It measured 8.2 and killed 800,000 people. Only five days earlier the French had tested a bomb in the Mururoa atoll in the Pacific Four days later the United States tested a bomb in Nevada. Twenty-four hours later the earthquake hit China.

Killer Quakes & Bomb Tests

In an even more revealing analysis, Whiteford studies so-called "killer earthquakes" in which more than one thousand people have died. He compiled a list of all such 'quakes since 1953 and matched them with nuclear test schedules. Some dates were not available, but in those that were, a pattern was evident: 62.5% of the killer earthquakes occurred only a few days after a nuclear test Many struck only one day after a detonation. More than a million people have now died in earthquakes that seem to be related to nuclear tests. Again, the governments of nuclear nations claim the results are mere coincidence. Officially the US energy department maintains that even their most powerful nuclear tests have no impact beyond a radius of 15 miles. The claim is challenged by the instruments of modern seismology that can register nuclear tests anywhere in the world by measuring local geological disruptions. Whiteford speculated that although the reverberations may fade within 15 miles of test, they are merely the first ripple of a wave that travels through the planet's crust and spreads around the globe.

In 1991, the Nuclear Age Peace Foundation published Whiteford's findings in an article called Is Nuclear Testing Triggering Earthquakes & Volcanic Activity? In an interview with California State seismologist, Dr. Lalliana Mualchin, the foundation went on to inquire into the long-term effects of testing. Mualchin was asked if the cumulative effect of nuclear testing might trigger earthquakes and volcanoes. He replied, "A single nuclear test may have little *effect* on the earth, like that of an insect biting an elephant. But the cumulative effect might move the earth's tectonic plates in a manner similar to how a swarm of insects might start an elephant running. If an insect bites an elephant in a sensitive spot, such as an eye or ear, then there might be a vast movement out of all proportion to the size of the bite." The article concluded, "Who will the world hold responsible if suddenly an unprecedented series of violent earthquakes and volcanoes shake the earth? Will nuclear testers be able to assure the world they were not responsible?

Ten More Years of Tests?

Recent decisions announced by the Bush administration to "limit". tests in size and number for ten years are meaningless. They represent little or no change from what in fact has been the practice for the last several years. They avoid dealing with the mounting call by Congress and the world-through the UN.- for a halt by all nations to all testing forever. According to UPI, President Bush will actually veto any effort to halt testing. Bush says he wants testing to continue "for at least ten years" to check the safety and reliability of nuclear bombs. The Russians and the French no longer feel the need to conduct such "checks*, and have halted testing altogether. Why cannot the USA?

However, as the next presidential election nears, there is an emerging prospect of finally ending 50 years of bomb tests. Governor Bill Clinton's office says he supports a comprehensive nuclear test ban. His running-mate Al Gore is one of the supporters of the Congressional call for a one-year moratorium on testing.

From.The War and Peace Digest

Irradiated strawerries went on the market for the first time in

Action:
Protest Export Of Irradiated US Fruits

Florida, USA. The strawberries had been irradiated with cobalt 60 when the Vindicator, Inc. facility began operation in January. US consumer groups have already been voicing their opposition to food irradiation, with a great deal of success. Now it is generally under stood that Vindicator s main commercial target for the near future is outside the US: Japan. (Japan is already a large scale importer of Florida grapefruits and oranges) Consumer Union of Japan is coordinating a campaign against food irradiation. They are asking people to write to Sam Whitney, President of Vindicator Inc., to express opposition to the food irradiation business.

Whitney's adress:

Vindicator Inc., 1801 Thonotosassa Road, Plant City FL 33566, USA.

For more information on Food Irradiation, contact:

FoodlrradiationNetwork(FIN), International **Organization** of Consumers Unions,

PO Box 104540830 **Penang,** Malaysia.

The Fast Disappearing Fast Breeder

The Indian nuclear program is based on a dream—a dream of unlimited power locked in the uranium atom. Unfortunately, or rather fortunately, we don't have too much uranium.

The only working mines that we have are at Jaduguda in Bihar and the ore there is of poor quality and is anyway almost exhausted. (See Anumukti Vol.5 No.l) What we have in plenty in the monazite sands of Kerala coast is thorium. But the energy locked inside the thorium atom is too securely locked. Thorium does not fission. What thorium does do, under bombardment from neutrons, is to transform itself into a fissionable form of uranium called uranium-233.

The pioneers of the Indian nuclear energy programme were under no illusion regarding the availability of uranium in the country. Prospecting of uranium has been done more thoroughly than that of most other minerals. Thus, the chances of a new unexpected find' are somewhat slim.

To bypass the constraints imposed by the poor availability of uranium and still develop a totally self reliant nuclear power programme, the pioneers like Dr Homi Bhabha and Dr Vikram Sarabhai conceived of a three step strategy.

The first step was the construction of ordinary (thermal) nuclear power plants. Normally when an atom fissions, it breaks up into two nearly equal bits and two or three neutrons. The neutrons that are released, move at a tremendous velocity. At least one of these neutrons has to hit another fissile atom and cause it to break up, for the chain reaction to proceed. The chances of these fast moving neutrons hitting the nucleus of another atom and causing fission are quite small. However, if they can be slowed down in some way, then the chances of their causing further fission are greatly enhanced. This slowing down of neutrons is called 'thermalising' in nuclear jargon and is accomplished by having a 'moderator' in the system. The action of the moderator is akin to that of a crowded bazaar. Neutrons loose their speed through repeated collisions with atoms of the moderator. The CANDU type reactors which are most prevalent in India use heavy water as moderator. Heavy water has an advantage over ordinary (light) . water since it absorbs far fewer neutrons. Thus, the chain reaction can proceed even when the amount of fissionable kind of uranium (uranium-235) present in the system is quite small. Other types of reactors, which use light water in their moderating and cooling systems, need to have a much richer mixture of uranium-235. However, having these thermal nuclear power plants was not a solution to our energy needs since they would soon consume all the scarce available uranium.

If the world nuclear industry were to continue and not die a well-deserved death, paucity of uranium, would within the next century, become a world-wide phenomena.

Hence the second step in the strategy: this was the construction of fast breeder reactors. A breeder reactor is one which produces ('breeds') more fissionable material than it consumes. This is possible because not all atoms of uranium happen to be of the fissionable kind. Most (993 out of 1000 in naturally occurring uranium are of the kind that do not fission (uranium-238), but they can be transformed into a material

(plutonium) which is fissionable. Hence, the breeder reactors have in their core fissionable material (a mixture of uranium-235 and plutonium) which is surrounded by a blanket of the non-fissionable kind of uranium. The excess neutrons that are produced during fission are absorbed by the atoms of the blanket, and the uranium-238 there becomes converted into plutonium. The 'fast' in fast breeder reactors refers not to the speed of breeding, which is in fact, quite slow, but to the speed of the neutrons which are not moderated like in thermal nuclear reactors. Two questions arise here. Firstly, why use fast' neutrons and secondly why go through this rigmarole of first producing plutonium in a breeder reactor and then using this plutonium in an ordinary reactor with thorium? Why not directly use the abundantly available thorium in the already built thermal reactors in the first place? The answer to the question of the necessity of using fast neutrons is that while 'slow' neutrons are better at causing fission the number of neutrons released per fission on an average is more likely to be two rather than three, whereas in the case of fission caused by fast neutrons, the chances of producing three neutrons per fission are greater. One neutron per fission is needed for the chain reaction (fissioning of the next atom) and if breeding is desired, at least one neutron would be needed per fission for the purpose of converting non-fissionable material like uranium-238 or thorium into fissile plutonium and uranium-233. Since some neutrons are inevitably 'lost' — absorbed by the moderator, coolant, and structural materials like steel and concrete that make up the reactor, it is difficult to achieve breeding in ordinary nuclear reactors.

Therefore, the pioneers' strategy was: first build ordinary reactors, this would give some amount of

plutonium, though much lew than the uranium-235 that would be consumed. Use the plutonium in a fast breeder reactor to have more plutonium. And once, the plutonium supply was thus assured, to convert the abundant thorium into uranium-233 and take the country into an era of unlimited power.

Whereas, the availability of uranium was a specially serious concern to India, it was not the only country faced with this problem. If the world nuclear industry were to continue and not die a well-deserved death, paucity of uranium, would within the next century become a world-wide phenomena. Thus, many countries including U.S., U.S.S.R., U.K., France, Germany, and Japan besides India embarked upon a fast breeder programme. However, like rats deserting a sinking ship, the fast breeder programmes of many countries are being wound up one by one. The U.S. and Germany have already called it a day while U.K. has announced that its prototype fast breeder reactor at Dounray would be shut down in 1994.

The French were the frontrunners in fast breeder technology. They had not only built prototype fast breeders, but also a commercial scale fast breeder. Superphoenix was the largest and so far the only example of a large commercial scale operating breeder reactor anywhere in the world. This helps explain why the French state power company, Electricite de France (EDF), is defending Superphoenix despite its dismal history-a record number of breakdowns, the fact that it has operated at full power for less than six months of its six year existence-and its enormous costs.

DSIN (Direction de la Surete des Installations Nucleaires: the French nuclear regulatory agency somewhat akin to the Indian Atomic Energy Regulatory Board, except for the fact that it seems to have more teeth) has stated that, before authorizing a startup for Superphoenix, it wants to understand the mysterious and potentially dangerous variations in reactivity that for two years have been plaguing the Pheonix, the prototype of Superphoenix. DSIN in their report have highlighted the most serious failures suffered at Superphoenix: the discovery of tubing leaks in 1987, the entry of air into the reactor in 1990, and the collapse of the machine room roof in 1990 due to snow load. All of these according to DSIN "have statistical significance for the future." They are due, say DSIN, "too difficult technical problems that have been insufficiently mastered, or failures in designing must be considered that the probability of new failures appearing is significant." And despite heavy pressure from the nuclear establishment, the government is hesitant to override safety considerations for an increasingly controversial project. Concern with environmental issues and nuclear energy is rapidly

Iike rats ..deserting a inking ship, the fast breeder programmes of many countries are being wound up one by one.

rising in France, as illustrated by March regional elections where green parties won nearly 15 percent of the vote.

Now, Superphoenix will have to go through a long relicensing process for restarting. This would include public hearings, and that, say French activists, would probably finish it off. Didier Anger, national spokesperson for the French Green Party, says that unofficial ministry sources estimate that there are three chances out of four that the French government will abandon the project.

The French nuclear programme is the most extreme example of the quasi-military style of centralised administration that characterizes the French state. There is no place for separation of powers, democratic process *or* independent watchdogs in the French system. Thus, its nuclear program (civil and military) was developed by an elite government bureaucracy, the Atomic Energy Commission (CEA), acting on executive orders issued without any parliamentary oversight or involvement. The state owned electricity board EDF maintains a monopoly over all electric and gas power. Plant safety is controlled by the Ministry of Industry, but it relies on experts from the CEA Until the Chernobyl accident, monitoring of radioactivity was the responsibility of another bureaucracy which is so pronuclear that it denied the presence of the Chernobyl cloud over France. The CEA, rather than the universities, provides training in nuclear engineering, which helps minimise the number of nuclear engineers who might be critical of the industry. *{Editor's Annotation: Replace the word India for France in this paragraph and see if you can observe any difference.*)

The French government began its dramatic expansion of the country's civil nuclear program after the 1973 oil shock, provoking widespread opposition. But the government crushed the grassroots movement. In 1977, police brutally dispersed a march of 60,000 protesters at the Superphoenix site, killing one person and wounding 100 others. In 1981, when the Socialist Party came to power, promises to close Superphoenix and open a debate on nuclear power were quickly betrayed. The extra parliamentary opposition was co-opted *or* disheartened and the nuclear question was moved out of the political arena.

This began to change after Chernobyl. Until the 1986 Chernobyl disaster, most newspapers refused to publish any critical commentary on nuclear power. Immediately following the accident many journalists broadcast assurances (there was no significant increase in radioactivity over France and no reason to take preventative measures), only to discover that all neighbouring countries were destroying large stocks of vegetable and dairy products and . refusing to buy French products. The scandal led to the creation of France's first independent

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monitoring lab, the CRIIRAD, which besides monitoring Chernobyl radiation, has since discovered several significant hazards from France's own facilities. The spell was broken. And despite the media blackout, the grassroots opposition began to grow.

The nuclear industry suffered further blows in the late 1980s, as it searched for somewhere to dump its waste. It met with formidable opposition from farmers, environmentalists and local governments at three of the four potential sites it chose. As many as 15,000 protesters occupied sites and seized equipment. When attacked with tear gas, farmers fought back with tractors spraying pig manure. In 1990, then Prime Minister Michel Rocard was forced to announce a one year moratorium on new waste dumps and to organize, in June 1991, the country's first parliamentary debate on a nuclear issue. By then, environmentalists had leaked an alarming secret report on safety written by EDF safety chief Pierre Tanguy, further eroding public confidence. Among other things, the report discussed serious aging problems in reactors, important design defects in Pressurized Water Reactors, and most seriously, a re-evaluation of accident probabilities which now showed the risk of a serious accident to be at least 20,000 times higher than had been previously estimated.

The political fallout and the description in the report of the risk of accident as an important financial issue was something EDF was more concerned about than any health hazards involved. EDF claims to produce very cheap nuclear electricity, and often sells it below cost, thereby running up a debt equal to Poland's entire foreign debt. In fact, were it not for a guarantee from the French government which also holds down interest rates, EDF would be bankrupt.

The Superphoenix itself has already proved to be a major economic disaster. US$9 billion has so far been spent (six times the initial costs estimate) for a site that is still not finished or in working condition. Fuel reprocessing costs would push the bill even higher. EDF claims that the reactor will eventually produce electricity for only about twice the cost of standard PWRs, but it admits now that commercial models won t be viable until the middle of the next century.

That price estimate is misleading, since it does not take into account the costs of the whole fuel cycle, the reprocessing costs in particular. According to an independent analysis of the plutonium fuel cycle by economist Dominique Finon of the university of Grenoble, the reprocessing costs are so high that it would probably cost less to extract uranium from sea water.

The dangers of fast breeders are so great that even many otherwise pronuclear physicists oppose them. They are believed to be the only reactors in which there can actually be an atomic explosion.

The superphoenix houses more than six tons of plutonium (and CRIIRAD has already detected traces of it in the Rhone River).The dangers of fast breeders are so great that even many otherwise pronuclear physicists oppose them. They are believed to be the only reactors in which there can actually be an atomic explosion.

These dangers are inherent in Superphoenix's design, and were known well before the reactor started. With its record of actual operating experience - which includes an incredible series of impossible accidents (two of which had officially been estimated to have a probability if occurring not more than once in 10,000 to 100,000 years) - the DSIN safety authorities have understandably become publicly critical.

Growing Opposition

Despite the media blackout in France, opposition to the Superphoenix, long based in Switzerland (Geneva is only 45 miles away), has gradually grown. A recent poll in the Isere(the area where Superphoenix is located) indicated the 69 percent of the population believed that building Superphoenix had been a mistaken decision and that 78 percent thought the Superphoenix might become a second Chernobyl.

The Effect on Japan

Now that the French are not proving the ideal role-models for India, our nucleocrats are liable to shift their admiration towards the Japanese. Future pronuclear cheerleading is bound to have glowing references to the still expanding Japanese nuclear programme along with lot of blah-blah regarding the fact that Japanese are the only people ever to have suffered the effects of atomic explosions. However, the French government's decision not to restart the Superphoenix should also have a large impact on the Japanese nuclear industry.

The story regarding the French decision got little coverage from the Japanese news media, while the government and nuclear industry officials feigned indifference. PNC (Power Reactor and Nuclear Fuel Development Corp.) officials commented that their own Fast Breeder Reactor (FBR) Project Monju, which is scheduled to start next spring, would not be affected by the French decision because the difficulties with Superphoenix are mainly due to intrinsic maintenance problems and also because the loop type Monju is structurally different from the pool type Superphoenix. *{Now where have we heard that one before? Editor)*

Actually PNC was nervously waiting for the French decision, hoping that Superphoenix could be restarted. The decision came about one week later than generally expected. During this period, officials were desperately trying to get hold of all the information they could, so as to be prepared at any

time to comment that their programme would not be affected even if the decision was unfavourable. In spite of their comments, however, the French decision has a direct bearing on Monju, and they know this all too well.

For one thing, the decision not to restart Superphoenix was based on the safety report prepared by M. Laverie, chief of DSIN and the report raises serious doubts as to the safety of FBRs in general. The weaknesses and uncertainties that Laverie points out concerning Superphoenix are mainly related to the following three points:

The difficulty of controlling core reactivity. The potential danger of a sodium fire, particularly in the secondary sodium circuit.

The difficulty of inspecting the inside of the reactor vessel and steam generators.

These are problems common to all types of FBR and thus weaknesses of Monju as well.

It should be noted that the French decision seems also to be related to the prospect of a world plutonium surplus problem. In an age of surplus plutonium, it does not make sense to breed plutonium in a FBR. NERSA, the owner of Spx, decided three years ago to remodel the reactor from a breeder to a non breeding fast reactor. It can be said that the recent French decision on Spx has accelerated this policy shift from breeding to non breeding in France. Germany's decision last year to abandon the almost completed SNR 300 FBR also came years after remodeling it to a non breeder. In this context it is interesting to note that talks on the future remodeling of Monju to a non breeding fast reactor have just begun in Japan.

Ten days after the French decision, the *Mainichi Shimbun*, one of the national daily newspapers, reported that PNC had decided to convert the ATR(advanced thermal reactor) Fugen, a heavy water moderated light water cooled converter reactor of Japanese design which partly uses MOX as fuel, into a dedicated plutonium burner. This may be regarded as further evidence that the Japanese government now admits Japan is going to have a large plutonium surplus, as we have repeatedly pointed out. But the decision sounds very strange in the light of the fact that the government and PNC have always claimed until very recently that we need to breed plutonium for Japan's energy self sufficiency and we **must also have plutonium from Europe because without it we face a shortfall for fueling Japan's R & D plutonium projects. The decision to use Fugen as a plutonium burner probably reflects the change of perception which is slowly taking place inside the Japanese nuclear industry about the plutonium surplus, but the decision has apparently been expedited by the French decision on Spx. Hence the death of Spx is already affecting Japan s plutonium policy.**

Anyway, Japan is obviously going to face a large surplus of plutonium as the government itself now admits, and we would like here again to stress that there is no need for plutonium to be shipped back from Europe, even if the dangers of shipments can be minimized.

Surendra Gadekar

Sources:
WISE 371
Nuke-Info Tokyo

Contact:Olivier de Marcellus, CONTRATOM,CP 107, 1227 Carouge, Switzerland.

CRII RAD, Lo Cime,471 Avenue Victor Hugo, 26000 Valence, France.

33 Power Projects Facing Cost Overruns

A review of the power sector, has revealed that of the total 39 mega and major projects, 33 are behind schedule and 31 face cost escalations of 77.6 percent.

The cost of the 39 projects has jumped from the original estimated Rs 17368.1 crore to Rs 3,11,736 crore, registering an increase of 77.6 percent.

Due to project slippages, less than 50 percent additional capacity was added during 1991 92; against a target of 1,880 MW, only 908 MW was added during the period. Top officials are highly skeptical that the current year's target of commissioning 2,890 MW would be met

According to official sources, the cost of 31 projects has shot up from the original estimate of Rs 15,845.1 crore to Rs 29,715.1 crore— an increase of 87.5 per cent. The time overrun in the case of 33 projects ranges between *one* month and 128 months. The cost of these projects has risen from Rs 14,510 crore to Rs 27,046 crore.

The reasons for delay in project completion are:

Delay in environment clearance, notably for major projects including Farraka Super Thermal Power Project (STPP), Kalgoan 'STPP, Kalgoan transmission line and Doyang which are stuck with the Department of Environment.

Controversy between Uttar Pradesh, Madhya Pradesh, and Bihar over the reallocation of water from the Renusagar reservoir, delaying the Vindhyachal STPP, which the meeting felt should be resolved immediately.

Land acquisition problem is holding up Kalgoan, Farraka STPP 11, Talcher, Bokaro B 11 Majijia, Ranganadi Doyang and Koel Karo; serious funding problems for Farraka STPP 111 and Vindhyachal Transmission system.

Law and order problems in Jammu and Kashmir are delaying the Ori and Dulhasti, and the Kagalgoan and Farraka due to the Jharkhand Mukti Morcha.

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Nuke Project That Failed To Take Off

The agreement between India and the Soviet Union regarding the Koodangulam nuclear centre, which has now been scrapped, was the culmination of eight years of negotiation on the technical and economic aspects of the Soviet offer first made in 1979 when then Prime Minister Morarji Desai visited Moscow.

Under the agreement, two 1000 MW units would be set up, the first by the end of 1998 and the second exactly one year later, according to the chairman of the Atomic Energy Commission, Dr. M.R.Srinivasan, in October 1988. The project was taken up by Atomenergoexport, a Soviet foreign company.

Practically all technological systems of the project were to be made available by Soviet Union. The USSR was also to provide the fuel, but India was free to get the enriched uranium from wherever it could. The spent fuel was to go back to the USSR, both because it had better storage facilities and less population and because India wanted to avoid complications regarding the weapons grade plutonium that can be derived from reprocessed fuel.

Koodangulam was chosen as the site for the reactor as it was seismic activity free, a sparsely populated area but with availability of water and proximity to the sea.

The Koodangulam project was opposed by quite a lot of people, starting with the villagers of the coastal areas. They were apprehensive that the radioactivity would harm them. Fishermen were against it because they feared destruction of marine life. But villagers in the interior were enthusiastic, trying to get the maximum possible for their lands.

Part of those opposing the scheme, the Committee for Sane Nuclear Policy (Cosnup) even decided to ask the Centre to scrap the project to set up two VVER 1,000 MW nuclear reactors, saying that they were obsolete and **flawed. Cosnup convener Prof. Dhirendra Sharma said that the Soviet Union itself had suspended installation of 20 VVER reactors after the Chernobyl accident, and anyway its technology had been developed 20 years ago.**

Justice V.R. Krishna Iyer, national chairman of Cosnup, also supported the demand.

The reasons for their opposition were: 1.The friends of Nature Society said there were no water sources in the arid area to supply the water necessary for a nuclear plant, and it would also be a Herculean task to link the power generated from there to the national or state grids;2) The plant was of no use to the displaced villagers as most of them were far too poor to benefit from it, having only thatched houses;3) Fishermen were afraid that marine life would be affected;4)Radiation was already high in Kanyakumari district because of natural radioactivity from the monazite deposits along the coast; and 5) Villagers and environment conscious organisations were absolutely against giving water from the Pechiparai reservoir as the area was already starved of water.

President of Atomenergoexport. said that a Chernobyl type disaster was not possible in Koodangulam because the reactors were the VVER 1000 type, not the RBMK as in Chernobyl. And only one percent of pechiparai reservoir's capacity would be required for the plant.

VVER 1000 is a water cooled and water moderated reactor, with the core in a thick metal shell with a sphered lid, preventing radiation leaks and breakdown of the reactor. It is also earthquake resistant, able to withstand a 8 point quake on a 12 pt scale. It also allows for use of sea water for cooling ancillary equipment.

The reactor has three barriers to prevent radioactivity -sealed around fuel elements, heat transfer circuit and localisation of

fission products in limited space.

Project director V.S.Gopinatha Rao also reassured the fishermen, saying that coolant water would not pose any danger to marine life. He said the condensers were so designed that the water that was let into the sea would not raise its temperature by more than 5 degrees C.

All the same, objections were periodically raised,like those by Dr. Dhirendra Sharma, who insisted that VVER reactors were not safe either, as they no longer were to be built in the Soviet Union which scrapped five which had already been built.

Between the objections and the denials, the project did not really take off. In early January 1990, the then Union Minister for Science and Technology, Mr.M.G.KMenon, said that the Government of India had not taken a final decision on the plant. The Government would look into the project in its totality, including cost, economics, etc. No agreement had been entered into on a final basis with the Soviet Union, he stressed, adding that it would only be after the Detailed Project Report.

The quick changes in the Soviet Union in mid 1991, once again stalled the Koodangulam project.

As recently as December 1991, AEC chairman P.K.Iyengar said it would take two months at least to know if the reactor would be set up with Soviet help or without, due to the rapid changes there. And project director C.R.Prabhakaran said infrastructure work under the Rs.7 crore first phase was being carried out.

On December 4, 1991, Dr Iyengar asserted that the Atomic Energy Department would go ahead with putting up the four pressurised heavy water reactors (PHWR) of 600 MW each with Indian knowhow, even if the Soviet agreement fell through.

Letter Box

At you know, there it a nuclear plant of high accident rate not Car off St Petersburg. We are interested in genetic effects of the wastages from the plant Our lab tracks Down's syndrome and congenita] malformations rates in Leningrad-St Petersburg since 1982. It is very interesting to compare the dates of Urge accidents with dynamics of Down's syndrome rate in the city as a whole and in the districts of the city. However, despite 'Glasnost' information on accidents is still not available. We are making efforts to discover this information and hope to achieve success.

We have obtained information on a big accident in 1975 (See following). This accident affords the possibility of monitoring immediate genetic effects and as well the possibility of learning about late genetic effects.

In 1994, young women conceived at the time of accident in 1975 will be giving birth to their children. Marital age in Russia is 18 years, and we are waiting the start of Down's syndrome rate elevation (if the conception of irradiation influence on meiotic chromosome pairing is correct).

Unfortunately, under unlucky situation in our country such fundamental explorations usually fail to receive financial support. Moreover, we are afraid we shall have to stop our investigations in the nearest future.

Taking into consideration the significance of the problem, we hope to attract the attention of foreign scientists, with the purpose of founding international collaboration in this topic.

SUBSTANTIATION OF THE PROJECT OP EXPLORING GENETIC EFFECTS OF THE ACCIDENT ON THE LENINGRAD NUCLEAR POWER STATION IN 1975

The problem of the effects of low dose radiation on human germ cells is one of the most important in radiobiology. It it alto of great significance to medical genetics.

To date, there are a lot of indirect contradictory data that cannot elucidate the problem. That's why scientists pay special attention to accidents that could result in genetic effects in big population: Hiroshima explosion, accident in Kystym and Chernobyl, etc

But for the number of reasons, correct experiments on distant effects of these events cannot be carried out One of them is that humans can regulate childbearing taking into consideration possible consequences of irradiation . Thus, after Chernobyl accident, for instance, birth rate in old age groups of Byelorussian women, presumably most radiosensitive, considerably decreased. Hence, the most correct experiments can be carried out only in population that underwent irradiation being unaware of it (In Kyshtym, both physicians and administration knew the truth and deliberately distorted statistics.)

Such a situation occours in Leningrad on November 30th.
1975 as a result of partial core melt down. The reactor was stopped and blowed off with nitrogen through a 150 meter high chimney. All in all 1500000 Curies of radioactive waste was released into the atmosphere.

The accident was first mentioned on a closed meeting of the cabinet of ministers in March 1976 by Prime Minister Kosygin. He reported about a request of Finnish and Swedish Government of the increased level of radioactivity above their countries.

Visual analysis of synoptical maps on barometrical altitude 850 milibars and 200 milibars showed that in the period under study the S-SW air mass movement took place, and radioactivity could have passed throughout the city. More precise analysis after estimation of radioactive particles trajectory. Resulting from this scoring the regions of most pollution would be determined.

In Leningrad owing to established practice, all live births with congenital malformations am subjected to genetic examination including cytogenetic investigations. The part of affected children died soon after birth remain unexamined. Thus the significant part of children suffering chromosome diseases is registered in annals of both municipal medical genetics survey and science laboratory on medical genetics (Academic Group on Medical Genetic of Associated Member of the Russian Medicine Academy, Prof. EF Davidenkova.)

The laboratory serves 8 maternity hospitals (out of 20 such institutions of the city) since 1970. Observing the chromosome analysis records from 1974 to 1980 we revealed the elevation of the number of chromosome anomalies in 1976, next year after accident.

Analysis of the data of 1965 to 1979 published by Finnish scientists revealed the elevation of Down's syndrome rate in new borns in Finland since 1976 (Leisti et al Clin. Genet.; 1985:27,3.252 to 257.)

We are far from the proved conclusion that this was result of action of radiation of germ human cells. But we believe that the data mentioned above is the serious substantiation for careful retrospective investigation in this field.

We suppose:

1. Processing the archives (not computerised) of all maternity hospitals of the city since 1970 in purpose to determine the birth rate, the levels of child death, Still births, congenital malformations and Down's syndrome.

2. Study of anamnestic parental data (age, lace of birth, nationality, occupational hazards, obstetrical, gynecological anamnesis) in comparison with the selected control.

3. Detalisation of obstetrical-gynaecological data (in the cases of incomplete birth certificates) in maternity consultations (not computerised)

4. Study of the records of pathological archives (not computerised) for recognition of syndromes.

5. Multiparameter statistical analysis for determination of leading factors causing the

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hereditary and congenital defects and estimating the role of irradiation.

It is obvious such exploration to be actual and not of common to all biology. Nevertheless in Russia we are not able to find institution interested in this problem. To our knowledge there are several international programs concerned with the effects of Chernobyl's accident on human health. We hope the outcome of the study suggested would be useful for prognosing genetic effects of such tragedies.

We appeal to you with a request to include our project in appropriate monitoring program.

The study would be completed in one year provided the financial support is $10,000.

The prospect for financing of the work and we would grateful for aid in searching possible sponsors.

Reproduced in toto from **a** letter written by a Russian Scientest

Contact V.T. Padmanabhan, CISEC, Kottamuku, Quelion.

I have taken serious note of your fast from September eleven to fifteen. I agree with you completely that integrated testing of the ECCS (Emergency Core Cooling System), a safety system should be done and not in piecemeal in the public interest. I am writing to the Center to look into this matter.

Chimanbhai Patel
Chief Minister of **Gujarat**

I have decided to undergo a five day's sympathetic fast with Narayanbhai. Work here prevents me from going to Vedchhi. We had a meeting of friends from the Manaviya Technology Forum. They have decided to observe a one day sympathetic fast on 11th September.

It would be interesting to know the reaction of the authorities. Please make diagrams and explain in simple Gujarati what an Emergency Core Cooling System is and what are the implications to safety of such callousness. Please send us some copies of leaflets.

Rajani Dave
Prayas, Mangrol, Bharuch Dist.

Editor's Comment: The AERB chief, Mr. Soman came to Vedchhi to discuss the matter with Narayanbhai but did not come to the point till they were leaving. Most of their time was spent in explaining their independence from DAE. Mr. Soman gave an unsigned document which shows that they had tried to perform some ECCS tests in February 1992, and found results not upto the designed specification. New standards were set and the repaired portions were tested in June and August 1992. Obviously, the AERB gave permission for fuel and heavy water loading before being sure that the ECCS would work in toto. The ECCS should have been tested before allowing the fuel or heavy water loading. An integrated test would mean rushing in of tons of simple water into the expensive heavy water.*

Rupa Chinai's article 'BARC Spews Radioactive Poison' (Sunday Observer. Sept.7) and 'Chernobyl in the Making' (Sept. 13) has stirred people in Bombay. As of today the BARC has not challenged a single incident or fact of the several enumerated by Ms. Chinai. A demand for the right to know and for accountability on the part of BARC is the outcome.

The Anumukti Bombay Group met at the Bombay Sarvodaya Mandal to work out an appropriate action plan. Suggestions made then and in the follow-up discussions were:

- Rupa Chinai to be supported and commended for the* service she has rendered by enlightening the public on matters pertaining to health and safety of the environment. It is a service not only to this generation but also to future ones, since radioactivity damages our genetic pool.
- Encourage Doctors to independently investigate health effects of the accidents.
- BARC disasters and its implications with emphasis on:
- Remedial **measures**
- **Queries (esp. about the** contaminated soil)
- Health/Ecological Angle
- Human Rights (esp. of the BARC casual contract labourers)
- SARCOPs (Safety Review Committee for Operating Plants) responses to this issue.
- Dissemination of information to the common man about the happ- enings at BARC in particular and the hazards of nuclear power production.
- Dismantling the 'Holy Cow' attitude towards nuclear issues.
- Dissemination of information to villagers around nuclear power plants of the hazards they face.
- Letters/articles to be written in Hindi/Marathi etc. to press and periodicals on the happenings at Trombay.
- Demand for an open debate on safety of nuclear power plants with an emphasis on the right to information.
- Decision to network with NGOs in Bombay, and anti-nuclear groups in India regarding BARC's fall out.'
- Inviting individuals for: suggestions & support (Letters, signature campaigns, information)

All mail may be addressed to the Anumukti Bombay Group at the Bombay Sarvodaya Mandal, 299 Tardeo Rd., Nana Chowk, Bombay.

MONAPATRAO
BOMBAY

Narayanbai's 5 days fast in resp- onse to KAPP going critical without adhering to safety norms is appropriate.

Perhaps this nonviolent **protest** in the land of Ahimsa may catalyse the authorities not to **take such a** callous attitude with regards to the public's safety.

KANTIBAISHAH
EDITOR: BHOOMIPUTRA
VADODARA.

Asian Rare Earths Ordered to close

A Malaysian court on July 11 ordered Mitsubishi s joint venture Asian Rare Earth immediately to close its plant in Bukit Merah and remove all radioactive waste and toxic chemicals from the factory.

The ruling ends a seven year suit brought by eight Bukit Merah villagers against the firm, which was 35% owned by Mitsubishi Kasei. Asian Rare Earth processes monazite to produce yttrium and other rare earth chlorides used in color television screens and other electronic parts. In the process, radioactive thorium is produced as waste, and this waste was virtually dumped in the backyard without any signs or fences to protect the residents. Local residents have suffered cancers, leukaemias, and birth defects, caused by high levels of radioactivity. The ARE case had been dubbed a Japanese pollution export by environmentalists.

This ruling was the first of its kind in which a multinational giant has been ordered to close down because of environmental damage and adverse effects on the local residents. The ruling has been a great shock to the Japanese government as well as the industry. The Ministry of International Trade & Industry immediately announced that they feel deeply regretful over the issue and summoned Mitsubishi Kesei to explain the situation. The Director General of the Environmental Agency also called in the directors of the company for a briefing. The industry has likewise shown regret, saying, when a firm wants to go abroad, it should not only satisfy the local law but also get the acceptance of the local people.

Two residents of Bukit Merah, Mr. Lau Fong Fatt and Mr. Hew Yoon Tat.came to Tokyo and visited government agencies and Mitsubishi Kasei, in an attempt to persuade the firm not to appeal and to close the plant for good. During their visit, the ARE, contrary to their wishes, filed an appeal in July 23 and applied the next day for a stay of execution of the injunction to stop operation. Mitsubishi Kasei claimed the decision had been made on the Malaysian side alone without the consent of the Tokyo office and made statement saying that we cannot help expressing out regret towards these measures taken by the Malaysian side, but will continue insisting on our basic position, which is that the plant should not continue operation unless it harmonizes with the local people.

We have yet to see the outcome of the case.

(Nuke Info Tokyo July/Aug. 1992)

APPEAL FOR INTERNATIONAL ACTION

Free Vanunu for a Nuclear Free Middle East

Send the following message supported by as many signatures
[possible to: 6 Endsleigh Street, London WC1H ODX, UK.

" We the undersigned, call upon the people of Israel and their Government to release Mordechai Vanunu from prison.

Prisoner Of Conscience

Moroccon born Mordechai Vanunu, immigrated to Israel at the age of 11, along with his parents and their ten other children. After an adolescence of poverty followed by three years of service on the Golan Heights in the Israel Defense Forces, Vanunu was trained as a nuclear technician. From 1977 to 1985 he worked at Dimona at the underground Machon II lab, Israel's top-secret plutonium separation plant.

He began to question his own work on a secret nuclear weapons programme. Like Daniel Elsberg and Robert Aldridge in the US, he finally decided to make public his Government's secret Policy for the sake of truth and democracy.

In October 1985, The London Times persuaded him to visit London where a series of British scientists became convinced that his detailed story and photographs were genuine evidence that Israel's nuclear weapons programme was far more extensive than believed, making it the world's sixth most destructive nation with as many as 200 nuclear bombs.

Before Vanunu's story hit the press on October 5, 1986, its source had been kidnapped by Israeli agents. Vanunu had been tricked by a female Mossad agent into flying to Rome. There he had been overpowered, drugged, chained, and shipped to Israel on a cargo ship.

After a trail held in total secrecy, Mordechai Vanunu was sentenced to 18 years in Prison for treason, espionage and revealing state secrets. He is now at Ashkelon Prison, where he is about to begin his seventh consecutive year in solitary confinement. Amnesty International has described his conditions in a six by ten-foot cell as "cruel, inhuman, and degrading."

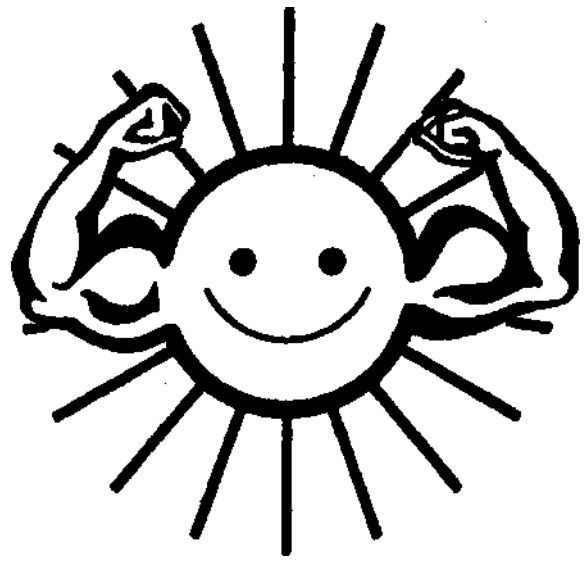
Israel executed Eichmann because he obeyed the directions of his superiors, and not the dictates of his conscience, when he killed thousands of Jews. Now Israel is punishing Vanunu for doing what Eichmann did not do.

I Am Your Spy

by Mordechai Vanunu

translated from Hebrew by Maxine Kaufman Nunn

**I am the clerk, the technician, the mechanic, the driver,
whom they told, do this or do that Don't look
to the right, to the left, don't eye the page. Don't look
at the whole machine. You are responsible for one bolt
only. You are responsible for just one rubber-stamp.
Concern yourself with one matter only. Don't bother
with things that are above you. Don't think
for us. Drive. Keep driving. On. On.
The great, the wise, those who understand our future,
thought:
There's nothing to worry about. No fear. Everything works,
clicks.
Our little clerk is a diligent worker. He's a simple technician.
He's the little guy.
Like all the low-ranking clerks, ears have they, but they hear
not,
eyes have they but they see not. We have a head;
not the little guys.
Answer them, he thought to himself
-just between him and himself-
the little citizen. But the man with the head
is not little. Who is the boss here, who knows
where the train is headed?
Where is our head. I too have a head.
Why do I see the abyss
Does this train have an engineer?
The clerk-driver-technician-mechanic raised
his head. Retreated a bit, saw a monster
Unbelieving, returned, rubbed his eyes and indeed -
they're fine. I'm just fine. I really do
see a monster. I am part of the system I
signed this form. And only now I am reading
the text. This bolt is part of a bomb.
This bolt is me. How did I not see
and how do others go on bolt-tightening.
Who else knows. Who saw, who heard
The emperor is indeed naked. I see him.
Why me. This is not for me. It's too big for me.
Rise up and cry out. Rise up and proclaim to this nation.
You can. I the bolt, the mechanic,
the technician. Yes you. You are the secret agent
of this natioa You are the eyes of the state.
Spy-agent, reveal what you've seen. Reveal
to us what those who understand, the wise, hide from us.
If you are not with us, the void awaits us.
A holocaust awaits us. You and only you sit
at the wheel and see the void.
I have no choice. I am a little guy, an ordinary citizen,
one of the common folk,
but I will fulfill my commitment. I have heard
the voice of my conscience. And there's nowhere to run.
The world is small. Small compared to
big brother. Here I am, on your missioa Here I am
fulfilling my role. Take this
from me. Come and judge. Lighten my
load. Carry it along with me. Carry
on my messenger-mission. Stop the train. Get off
the train. The next stop is nuclear holocaust**



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The next book, the next machine, no. There is no such thing.

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ANUMUKTI

A Journal Devoted to Non-Nuclear India

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What sets worlds in motion is the interplay of diffentices, their atttractions and repulsions. Life is plurality, death is uniformity. By suppressing differences and peculiarities, by eliminating different civilizations and cultures, progress weakens life and favours death. The ideal of a single civilization for everyone, implicit in the cult of progress and technique, impovcrishes and mutilates us. Every view of the world that becomes extinct, every culture that disappears, diminishes a possibility of life.

Octavio Paz

A Voyage that Diminished the Possibilities of Life

First came the visionaries-the seekers after truth, the people whose insatiable curiosity and genius led them to probe deeper and ever deeper into the mysteries of nature. People like Ernest Rutherford-the giant New Zealander whose ingenious experiments using a little bit of wire and some sealing wax were to alter the whole course of scientific development in the twentieth century; there was Niels Bohr, the Danish mountaineer and footballer, who gave us our picture of the atom-the most recognisable symbol of the modern age; there were the Germans Edwin Sehrodinger and Werner Heisenberg who gave the theoretical tools-the framework to understanding the secrete of the micro world* there was Paul Dirac the Hungarian physicist's physicist and his compatriot Leo Szilard—the man who dreamed the whole enterprise up and many others. And there was Enrico Fermi: "The Italian navigator who landed on the shores of the New World and found that' the natives were friendly."

That was the encoded message which announced to the American authorities that a nuclear chain reaction had been established and that it was controllable. On December 2nd, 1942, in a laboratory constructed underneath the squash court of the University of Chicago, Fermi and his group of co-workers, forged the key that opened the vast store of energy locked inside the atom.

Uranium is the heaviest naturally found element. Nucleus of atoms of uranium spontaneously divide into smaller bits, nuclei of lighter elements, and a few (sometimes 2 and sometimes 3) neutrons all moving at great speeds. The trick was to get these neutrons to act as triggers for further breaking up of other uranium nuclei. If this could be done on a suotained basis, then that was the key to the vast store of energy. The problem was that most of the neutrons were moving too fast. They would speed away before they could hit other atoms and cause fission. Fermi put a piece of parnffin wax in the way. The wax was to act like a crowded bazaar to the speeding neutrons. They slowed down, became more amenable to capture by other uranium nuclei and the chain reaction became sustainable. Like an-

other Italian navigator exactly 450 years before him Fermi landed the spaceship earth on the shores of the new world. But were the natives really friendly?

After the dreamers came the schemers. People like General Leslie Groves, who made useful products out of these discoveries. Like weapons of mass destruction. Groves wasn't the only one. There were many others: The political leaders: The top executives of large corporations: The military men. And they weren't all just Americans either. They were to be followed by the Russians, and the British, and the French, and the Chinese; and the Indians and the Pakistanis and the Israelis and the ...

After Hiroshima, the stream of nuclear scientists divided into three. One channel went on to make bigger and better (worse for you and me) bombs. These were people like Edward Teller—first rate scientist but a paranoid personality. Then there was the other stream-a small counter current. Scientist who said enough was enough and who tried to turn the clock back from the approach of midnight. And there was the mainstream. People who thought that nuclear energy was an inexhaustible, clean, cheap and safe source of energy and a solution to all the world's ills if only it could be harnessed and put to peaceful uses.

Many ingenious peaceful uses of nuclear by-products were found. There were the uses in medical diagnosis and therapy. There were agricultural uses, and in food preservation and in all kinds of gadgets from radioactive smoke detectors to starters in energy efficient tube lights, to watch dials that glowed in the dark. And on and on... No doubt there would be many more in the future.

But the main use apart of course from the weapons that nuclear energy has been put to was in boiling water and generating electricity.

But, on this, the fiftieth anniversary of Fermi's forays under the squash court, nuclear electricity faces an uncertain future. It has in a very deep sense proved itself to be "poisoned power". The very process of fission, leads to the creation of a bewilderingly large variety of poisons. Amongst these poisons are some of the most toxic substances known to humanity. Thus for example, a small spec of plutonium weighing no more than a trillionth of a gramme lodged in a person's lung can cause cancer. Nuclear power plants produce such poisons in quantities of hundreds and sometimes thousands of kilograms. Keeping these poisons isolated from the environment for essentially eternity has proved to be an insurmountable task. Far from being "too cheap to meter", nuclear energy has instead turned out to be too costly to continue. Despite huge government subsidies, (totaling according to the government's own estimate to more than $ 40 billion by 1979 in U.S.A. alone, nuclear power has failed the market test and no new power plants have been ordered for the last eighteen years. Neither has nuclear energy been as safe and clean as its backers had claimed. Catastrophic accidents have taken place far too frequently and routine emissions have proved to have been far more harmful than previous expectations.

But as advocates of 'development' never tire to point out, there is no free lunch; somebody has to pay the price. The price has been paid disproportionately by the voiceless—the yet unborn generations, the indigenous people of remote regions where all the uranium mining and the bomb testing have taken place, by young children and by women. Dr Rosalie Bertell winner of the Right Livelihood Award has estimated this price as the untimely deaths of 32 million people.

Christopher Colombus had also found the natives friendly. The natives paid for their friendliness with the destruction of their lives and culture. The track record of nuclear colonialism has been much worse.

Congratulations Dr Gofman for the Right Livelihood Award

Dr John Gofman is one of my heroes. He did his Ph.D. in nuclear chemistry and then went on to become a medical doctor. Today, at 74 years of age, he is Professor Emeritus in Molecular and Cell Biology at the University of California at Berkeley.

While a graduate student in 1942, Gofman proved the flssionability of uranium-233 and developed the process which isolated the first workable quantity of plutonium and discovered several radioactive isotopes of uranium and protactinium. His pioneering work on the chemistry of lipoproteins has received several medical awards.

But good scientists, though not dime a dozen are still not very rare entities. Far more than being merely a good scientist, Dr John Gofman is a man of scientific integrity and has courage of his convictions. Thus, when he found that the health effects of low, officially 'acceptable' doses were in actuality killing millions of people, he put his entire 'career' and funding on line and said so. For his outspokeness, he was hounded by the radiation establishment. His books, *Radiation and Human Health, X-Ray3: Health Effects of Common Exams* and *Radiation Induced Cancer from Low-Dose Exposure* are all classics in the field. *Anumukti* is eagerly awaiting the yet to be published book on heritable health effects.

Allaying Public Fears

In the last issue of Anumukti, we mentioned that the Kakrapar Atomic Power Plant (KAPP-1) started functioning from the 3rd of September, 1992- Shri Narayan Desai had gone on a five day fast in protest against the starting of this unit without the mandatory safety testing. The fast has galvanised many in the vicinity of the plant to become active in their opposition to the plant. As part of our campaign, we had informed the local press and local and state level politicians of the implications of starting KAPP1 without fully testing out the Emergency Core Cooling System. When Shri Narayanbhai announced his decision to fast, this was conveyed to the State Government and to some political leaders in the state. The Narmada Development Minister, Shri Babubhai Jasbhai Patel, forwarded Shri Narayanbhai's letter to the Prime Minister along with a note of his own. The Prime Minister's reply dated October 9, 1992 reads:

Dear Shri Patel,

Thank you for your letter of September 7,1992.

You may have received by now the clarification sent to you by Dr. P.KJyengar, Secretary and Chairman, Atomic Energy Commission, at my request. A copy is enclosed for ready reference.

I hope you will be able to use your good offices with the Sarvodaya leader, Shri Narayanbhai Desai, to allay his apprehensions.

Energy is vital for our progress. Nuclear energy is one of the most important energy sources available to us. Safety systems are important in all industrial undertaking and our approach to them should be positive and constructive. As you will notice, the safety systems in KAPP-1 are supervised by the Atomic Energy Regulatory Board and the expert committees it has set up to monitor the detailed operation and testing. I am glad Shri Desai is taking such a keen interest in the nuclear power plant. I am certain that his misgivings will be allayed by the Atomic Energy Regulatory Board. The Chairman of the Atomic Energy Regulatory Board, Shri S.D.Soman will be available for any further clarifications if required.
With regards,
Yours sincerely
P.V.Narasimha Rao

We also reproduce Dr P.K.lyengar's letter in full

No.6/6(14)/92-PP/789
September 8, 1992

Dear Shri Patel,

We have seen your letter dated July 28, 1992 addressed to the Prime Minister regarding Kakrapar Atomic Power Project-I. The question of adequacy of safety systems in KAPP-1 is decided by the Atomic Energy Regulatory Board and the expert committees that it has set up to monitor the detailed operation and testing. It is only after their approval that KAPP-1 attained criticality. A monitoring mechanism by an independent group has been established for this purpose, and the Department of Atomic Energy relies on their verdict. The Nuclear Power Corporation is responsible for the construction and operation, and is subject to the approvals given by the Atomic Energy Regulatory Board

In this connection, we may point out that individual opinions could be coloured and that is the reason why a committee of experts is asked to decide on such issues. Leaders in society should also value the opinion of such experts before coming to decisions on the social implications of such safety measures. I am sure that the Chairman, Atomic Energy Regulatory Board. Shri S.D.Soman, will be available for anybody who wishes to get clarified on any problem with regard to KAPP-1.
With regards,
Yours sincerely,
P.K.Iyengar

AERB Chief Visits Vedchhl

We received this letter much after Shri Soman's visit to Vedehhi.

Shri Soman spent one and a half hours with us. His major point too was to show that AEHB was independent of the Department of Atomic Energy (DAE). As proof he offered AERB annual report which is a separate document and not part of the annual report of DAE. However, on questioning he admitted that this was the first year in which the report had been published separately and previously AERB 's report used to form part of the DAE report. Shri Soman and the other officials who had accompanied him, did not say a word about Emergency Core Cooling System (ECCS) in KAPP-1 till they were just about to take leave and had in fact stood up to do so. At that time Shri Soma n brought out an unsigned note (on plain paper not AERB stationary) and handed that over with the comment that testing of the ECCS had been " done in an integrated fashion" at KAPP-1 and found to be satisfactory. On being asked "then how come Shri Natarajan and Shri Ghosh (who are both members of the AERB constituted safety committee) had written their note," he made no reply. He replied in the negative when asked if he (Soman) had called Shri Natarajan to ask him why he

(Natarajan) had written such a note when the ECCS had been found to be "satisfactory".

After the visit to Vedchhi, a press release was issued by KAPP authorities claiming that "Shri Soman had set all Shri Narayanbhai' s fears at rest." Whereas, during the visit, he evaded giving a direct answer to the only question that Shri Narayanbhai put to him, that was "Does the AERB or the DAE consider the health and safety of the people living in the vicinity of the plant, to be their responsibility?"

Reply to the Prime Minister

The following is an edited text of the letter written by Shri Narayan Desai to the Prime Minister, which was forwarded by Shri Babubhai J Patel along with a note of his own. What I have edited out are portions which summarized Dr Iyengar's letter, since we have reproduced the original letter in full.

Dear Pradhan Mantriji,

I am thankful to you for your letter October 9, 1992 in response to Shri Babubhai Patel's letter in connection with my fast.

At the outset, let me confess that Dr. P.K Iyengar's letter that you have enclosed with your's is far from convincing.

Dr. Iyengar wants us to have faith in experts. It mast be noted that both Shri K,Natarajan and Shri Ghosh are 'experts', being members of the AERB constituted safety committee specially charged to take care of the safety aspect of the Atomic Power Plant in question. They are the very people whose opinion the AERB and hence ultimately DAE are supposed to respect and impiement. To my knowledge no representative of the DAE or the AERB has repudiated the substance of Shri K.Natarajan's note,-that integrated testing of the Emergency Core Cooling System (ECCS) as per design intent was not done in toto before the KAPP-1 was actually started. All that Dr P.K.Iyengar has done is to imply that there are differences of opinion in the committee, and the committee as a whole including presumably Shri Ghosh and Shri Natarajan have acquiesced in allowing the reactor to start.

In this connection, let me recall the facts regarding the point at issue, about which there is no dispute.

. l. ECCS at KAPP-1 was tested in Februaiy 1992.

2.The test showed that the system did not function as per design intent.

3.Parts of the system which malfunctioned were, probably, repaired and retested in June and August '92. However, full integrated testing of the entire ECCS was not undertaken.

. 4.Thus, whether the ECCS would function as required in an emergency situation is at present unknown and a matter of speculation and hope.

5. ECCS testing, in fact, could not be undertaken since the AERB had already given its permission for fuel loading and heavy water loading in the primary heat transport system. An ECCS test at that stage would have meant that heavy water worth hundreds of crores of rupees would have become contaminated and downgraded and hence useless for reactor purposes.

Let us be aware of what is at stake here. In case the ECCS does not function as required in an emergency situation, we would have a major disaster in South Gujarat, which would deal a crippling blow not only to the state of Gujarat but to the economy of the entire country. The example of Chernobyl (another instance which the experts claimed could never happen) is already before us.

In such a situation, I would like to submit that, if at all we could afford to make an error, the error has to be on the side of safety. I do hope and pray that there will not be an accident or a leakage of radioactivity in KAPP-1, but as responsible representatives of the people it is your duty to see that no action is taken that would endanger the safety of the people living around the Power Plant in any eventuality.

I must also point out that "independence' of AERB hardly has a meaning when we consider the fact that there have been numerous instances when DAE has gone ahead and done whatever it wished to do, being confident that AERB would retrospectively approve, and AERB has always done so. A case in point is the December 1991, massive leak of radioactivity from a pipe in the CIRUS reactor complex in BARC Bombay, reported in a series of three articles by Rupa Chinai in *The Sunday Observer.* Since the area where the leak was detected is crisscrossed by numerous other pipes, the Reactor Safety Committee recommended that all pipelines carrying radioactive effluents be tested, repaired if necessary, and confirmed to be no longer leaking before starting CIRUS reactor. The apex safety body, 'SARCOF which is directly related to AERB, gave its permission to start the reactor, subject to fulfillment of the stipulations of the Reactor Safety Committee, on 5th February '92. The reactor was started that very evening without the conditions being fulfilled. That very night, one of the fuel elements suffered damage releasing large amounts of radioactivity into the coolant system, which had to be pumped out through the pipeline which was known to be leaking and had not been repaired. This instance is a clear abdication on AERB's part of its regulatory responsibility and illustrates the contemptuous attitude in which this body is held by

officials of DAE. AERB has till now not publicly reprimanded anyone for this violation.

Before concluding, I would like to quote from the report of the Kemeny Commission, which was set up to investigate the causes of the Three Mile Island accident in USA. in March 1979.

"After many year's of operation of nuclear power plants, the belief that nuclear power plants are sufficiently safe grew into a conviction. One must recognize this to understand why many key steps that could have prevented the accident were not taken. The Commission is convinced that this attitude must change to one that says that nuclear power is by its very nature potentially dangerous, and therefore, one must continually question whether the safeguards already in place are sufficient to prevent accidents."

I would, therefore, request you to note the seriousness of the matter and not to be guided solely by the advice of these experts, especially when experts seem to differ so drastically with each other on a matter that could have catastrophic consequences.
With kind regards
Narayan Desai

Comments

It is the duty of responsible public servants to allay public misgivings regarding various facets of government policies The best and in fact the only way in the long run to do this, is to openly confront problems, honestly investigate, make the results available to one and all, so that the general public becomes a partner in the governance of the country, and ordinary people feel that they have a say in policies that affect their own lives. Instead, what we have is that "Allaying Public Fears" is a game which politicians and "experts' play with gusto. Our leaders **tell us, whom can we trust if not the experts. The head expert tells us, you cannot trust what a single or in this case two experts say when they feel that no outsider is listening, but you can only trust the public statements of a committee of experts. It is well known from all walks of life, that experts are capable of good advice only at times when their own personal interests are not at stake. Whenever there is money to be made or the prospect of career advancement are apparent, doctors advice unnecessary operations, teachers advice unnecessary tuitions, engineers approve unsafe structures, nuclear regulatory bodies approve of untested designs. In such a situation, public safety can only be insured not by relying on the opinions of expert bodies, but by the activities of an enlightened citizenry.**

Recently, following the flurry caused by reports regarding the high prevalence of disease and deformities around the Rawatbhata Atomic Power Plant, the Department of Atomic Energy has decided to conduct a survey of cancers amongst their own permanent workers and their families at Tarapur. Such a survey is unlikely to come up with any thing of significance for the following reasons:

l.The 'healthy worker effect': The permanent staff of any industrial undertaking including nuclear stations is better fed and has generally abetter standard of living and health than the population at large. Thus, even at Ilanford, studies have shown that nuclear workers as a group have less number of cancers than the general population. It is only when comparisons are made between groups that are comparable, that one can get sensible results.

2.Tampur is a bad choice for such survey since, there are many other confounding factors pre. sent. There is **a** lot of other industry nearby. A good number of the nuclear workers don't live **at** Tarapur but commute from Bombay, etc. Thus, even if one finds something significant, one would not know what to attribute it to.

3.The permanent staff of nuclear power plants, by and large does not do the really 'dirty jobs. That honour is conferred upon the hapless 'casual' workers most of whom live in the vicinity. These poor fellows are not considered as nuclear workers except when the question of the applicability of radiation limits comes up. Thus, though they probably receive the largest doses of radiation, their health is not regularly monitored, nor are any records kept. In case a comparative study was to choose its control group from this sample, peculiar results are bound to come up since the presumable unaffected group would in reality be the more affected one.

However, even despite all these problems with a study at Tampur, DAK still wants to do such a study of its employees, the way to do an honest study would be to not look only at effects like cancel which take decades to show up, but at the general pattern of disease and deformity and then try *to* see if this pattern was in some way peculiar and not found in other truly comparible groups. That way mething could emerge that would I e of real benefit to the workers Unfortunately, the purpose of DAK studies is not to be of use toanyone, but only as a tool in the game of 'allaying public fears',

Surendra Gadekar

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(We apologise for being grounded!)

The Uranium Concentration Camps

In Europe, as in America, the postwar call to arms forced a rapid expansion of the uranium mines of the Erzgebirge, employing many tens and ultimately hundreds of thousands of miners. Recently discovered documents reveal that following a secret agreement in November of 1945 the Soviet Union was granted exclusive rights to all the uranium mined in Czechoslovakia. These mines in Bohemia were greatly expanded under Soviet supervision and began producing ore for shipment to the east. Bohemia was destined to become the primary source of uranium for the Soviet Union until the 1960's, when large deposits were discovered and developed in Kazakhstan and Central Asia. The Schneeberg mines of Saxony were also revived under Soviet occupation: uranium ore figured as part of the war reparations paid by the East Germans to the Soviet Union.

In the 1950's, about the same time that U.S. health authorities began to take the problem seriously (at least at the level of research), Czech health officials began to study the health effects of uranium mining. Health records and vital statistics were gathered on uranium miners, coordinated by a Health Institute of ' the Uranium Industry, established in the mining town of Pribram in 1954 for this purpose. As in the U.S., Czechoslovakian efforts to publicize the health problems of the miners ran up against cold war fears that releasing such information would compromise national security. In I960, Dr Vladimir Rericha of the Health Institute of the Uranium In dustry was asked to prepare a comprehensive overview of the incidence of lung cancer among Czech miners. Between 19G0 and 1965, Rericha and his staff compiled elaborate epidemiological evidence that miners at Joachimsthal and Homi Slavkov were dying from lung cancer about five times the rate of coal miners and the general male Czech population — results that were similar to U.S. findings at this time. Rericha prepared a paper detailing his findings for the Health Institute in 1966, and simultaneously sought to publish his results in a more conventional scientific journal.

Rericha's efforts to publicize the carnage in Czech uranium mines were blocked By orders of the State Security Police. The report and its contents were classified and publication was barred in foreign or Czech periodicals — a ban that was not lifted until the Velvet Revolution of 1989. The logic behind the ban was extraordinary: as Rericha today recalls it, Czech security authorities said they were afraid that from uranium health statistics, one could calculate either uranium production levels, or the quality of uranium being mined, or both. For this reason, all information on rates of cancer in uranium miners was declared "top secret." The cynicism of such a ban, even on its own terms, was made apparent to Rericha in the 1970's. when he again tried to publish his findings. Rericha was again denied the right to publish, despite the fact that the administrative chief responsible for all Czech uranium mining defected to the West in 1970. With all the details of Czech uranium mining available to Western intelligence agencies, why were the health hazards of uranium mining still kept secret? One can only conclude that the Czechoslovak Authorities feared that revelation of the sacrifice of the country's miners for the sake of Soviet atomic power would not have gone over well with the Czechoslovak people.

The Czech uranium mines (where uranium was first identified and exploited) are well known. Not widely known (even to Rericha and his colleagues) was the fact that the Czechoslovak government organized 17 to 20 concentration camps at the three major uranium mines, in which tens of thousands of political prisoners were forced to work in the 1950s and 1960s. All of the prisoners forced to mine uranium were political prisoners. The scale of the prisoner camps was approximately equal to that of "civilian" employment in uranium mining. According to Secret Police Archives, numbers of political prisoners at the uranium concentration camps were:

Year	1951	1952	1953	1954	1955
Prisoners	9,029	11,280	11,816	9,655	7,974

The Number of Political Prisoners

By 1960 the number had dropped to 2,600, and by 1963 the political prisoners had been replaced at the concentration camps by a population of criminals.

Compared to civilian miners, the political prisoners bore the brunt of the hazard and received practically none of the compensation. Civilian miners were paid extremely well — about ten times the average salary of physicians, for example. But the concentration camp inmates were fo**raed** labourers, and the vast majority did not survive to enjoy the compensation that **was** finally awarded in 1989.

Robert Proctor

6.2

Where Have All The Babies Gone?

The British Medical Journal of 9th Februaiy, 1992 (vol.304 pp 343-6) carries **a** study by Prof. R.KAVhyte of McMaster University, Hamilton, Ontario, Canada which demonstrates **a** correlation between atmospheric atomic bomb test in the 50s and 60s and rise in infant mortality. Until now such correlations have been denied by all international radiation-protection bodies (like ICRP, UNSCEAR, BEIR) and health authorities world-wide.

High Statistical Correlations

The high statistical correlations indicate that there was an excess of 320,000 infant deaths in the period 1950-1980 in the USA and UK alone. All first day infant deaths, neonatal deaths (within the first 28 days) and still births were included in this study.

As an example, this graph shows the first day neonatal mortality (deaths/1,000 live births) for England and Wales and USA plotted against calendar years. Before 1950, (the beginning of the atom- bomb tests) the curves show a deviation: the mortality rate no longer continues to decrease but even increases slightly. After the cessation of the bomb tests in 1963, the mortality rate begins to decrease again, following a delay, until the curves at the end of the 60's resume the trend seen before the bomb tests. Similarly shaped curves were also **demonstrated for the excess** mortality in **the first** 28 **days after birth and the number** of **still births.**

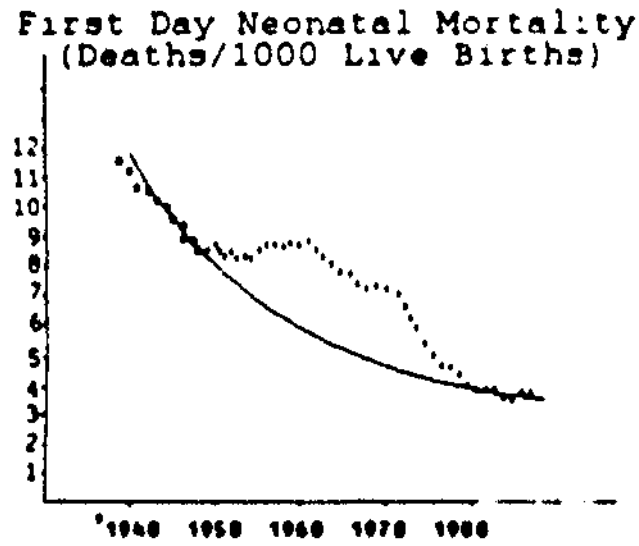
Confirmation of Previous Studies

More than three decades **ago, Prof EJ-Sternglass had already drawn** attention to such **a** correlation between physical and mental damage to humans and both the fallout from atom-bomb tests as well as emissions from nuclear power plants. The latter, even under normal operating conditions, also discharge atomic fission products similar to those found in fallout, such as strontium-90, iodine-131, carbon-14, tritium, krypton-85, etc. In his paper, Whyte also cites a study from Sternglass published in 1969 which demonstrates close geographical and temporal correlation between the increased strontium-90 pollution, as a result of the atom bomb tests bet ween 1950 and 1963 and an excess in infant mortality. Whyte also cites another study by Prof Jens Scheer of Bremen University, who showed that there was a 35 percent increase in infant mortality in southern Germa*ny* after the Chernobyl incident. Today there is a wealth of laboratory and epidemiological studies dealing with the effeets of Gill-out and low-level radiation on humans, animals and plants. All these findings should hopefully at last influence the radiation protection lawmakers.

Consequences for Society

In a memorandum on the implications of the Whyte study, Dr Sterglass says that in USA alone, 280,000 additional infants have died from 1950 to 1980 as a direct result of atom-bomb tests. Today, there could be millions of persons aged 10 to 45 years who have been harmed by the atomic bomb tests because some ten times more underweight babies survived which, nonetheless, frequently showed physical and mental problems. Therefore the greatest health and economic damage through fallout would not be increased rates of leukaemia **and** cancer among children, but instead an increase in premature and under-weight births. This would result in increased infant mortality, impaired pregnancy and immunological deficiencies in children that survive (though Whyte does not discuss immunological deficiency in his paper). For every thousand live births the number of underweight babies is some 100 times greater than that of children dying from cancer and leukaemia.

A recently published study by the Ukrainian parliamentary commission, shows that just six years after Chernobyl, there has been a distinct increase in cancer amongst children, a large increase in birth de-



fects and growth problems in both Ukraine and Byelorussia. In addition, it was pointed out that two to three and a half times more children are suffering from immunological deficiencies than before 1986.

Risks Underestimated

Therefore, according to Whyte, the health risks from fallout (any fallout whether from bomb-tests or from nuclear accidents like Chernobyl or

from the routine emissions from formally' operating nuclear power plants), have been underestimated by between 100 and 1,000 times because the radiation protection levels have only taken account of cancer and genetic defects! These 'acceptable' limits are based on the Hiroshima-Nagasaki data, which was the result of a single short-duration radiation burst. Such radiation damage is more easily repairable in contrast to the indirect damage caused by free radicals which takes place at low levels at low dose rates.

Supralinear Response Curve

The data from Prof Whyte support the growing evidence that in order to arrive at a maximal allowed concentration of fission products in milk, drinking water and foodstuffs, a linearextrapolation from high and externally received radiation doses like that of the Hiroshima victims is unsuitable. It follows that the most sensitive sectors of our society are insufficiently protected, namely the developing foetus and the elderly who both have weak immune defenses. Today it is irresponsible to still deny the supra-linear effect of radiation in the low dose region. Furthermore, the variations in radiation sensitivity among the population due to different factors like age, sex, illness, genetic composition, etc. have not been taken into account in the radiation protection laws.

Shut Down All Atomic Power Stations

At the end of February, 1992 the first International Conference of the newly formed Association for Radiation Protection took place in Kiel, Germany. It's theme was: New Assessment of Radiation Risks. Over 300 scientists and doctors took part in the gathering. The conference adopted a statement which was drafted by Prof Horst Kuni of the University of Marburg and the Otto-Hug Radiation Institute. The statement said, *"...we consider it safe to say that the collective dose released, as a result of the operation of atomic power stations, is sufficient to result in significant health risks to the employees as well as the general publie.*" It called for a total shut-down of all nuclear power plants.

Ralph Graeub

Ralph Graeub is a chemical engineer and a member of the Radiation Safety Group for the Swiss section of Physicians for Social Responsibility.

ATOMIC DECEPTIO OH, WHAT A TANGLED IC DECEPTION: OH, WHAT A TANGLED WEB!

A TOM

"The national security stale that the United States has evolved toward since 1945 is significantly a denial of the American democratic vision: suspicious of diversity, secret, mcuiial, exclusive, monolithic, parcnoid"

Richard Rhodes,
The Making of the Atomic Bomb

The Indian State is walking down the same antidemocratic path that the United States has traversed. Thus, it is interesting to know and note the similarities in the policy of lies and official deception and denial of access to knowledge that both states have followed. The following is an account of the 'war' the U.S. government waged on its own citizens in the name of "national security". Using the Freedom of Information Act, Hanford Education and Action League (HEAL) has gained access to once classified information on the governmental policies which allowed the secret releases of radiation into the air and the Columbia River. A number of these 'techniques' of information management have been used and are still being used also by the Indian nuclear establishment.

Hanford managers did take many precautions to limit exposures to radioactive and toxic materials. They were not totally cavalier, as some suspect. Radiation protection was a major concern in the design of the reactor and chemical separation

plants. But there were mistakes, there were accidents, and people

took chances with the health of others. Instead of confronting these imperfections and working honestly to correct the situations, the government adopted an official policy of cover-up. It feared the public's reaction to the truth and the loss of the ability to build atomic weapons.

An aspect to reflect upon is that the public's awareness about Harford's radiation did not start with the release of the once classified documents in 1986. There were rumours about Harford's radiation dangers as early as August 1945. Rumours continued throughout the fifties and sixties. The other noteworthy aspect is the fact that the government is still making it difficult for citizens to have access to historical documents about Hanford. Thus, while much has been learnt since 1986, still

more remains concealed, and the government is working actively to keep its own citizens in the dark.

Was Ignorance the Cause?

During the past eight years, many scientists and Hanford officiaIs have said that the reason the large radiation releases from Hanford were allowed was due to incomplete knowledge among early Hanford scientists of the dangers of radiation. However, this comforting view is not true. The documents reveal that the officials knowingly exposed workers and the public to levels of radiation exposure which they themselves considered dangerous. They routinely ignored their own guidelines regarding atmospheric releases of radioactive iodine till early fifties and dumped radiation into the Columbia river right up to early 1960s.

The reason for operating Hanford's factories in this manner are not entirely clear. But it is fairly certain that during the Second World War, the desire to win the war as quickly as possible provided the main push. According to Hanford's first operations manager, Walter O Simon, "the pressure was tremendous." But after August 1945, the reasons are murky at best. The highest releases during 1945 occurred after the Japanese surrender, when apparently there was no hurry'.

It is not as if Hanford officials did not take any precautions—they did. Within the plutonium facilities, they constructed the ventilation systems to suck the contaminated air away from those areas occupied by workers. Another precaution was the high emissions stacks on the separation plants. Simon recalled, "We did worry about gas emissions when the uranium from the reactor was dissolved to separate the plutonium. We monitored them *very* carefully, and ... if there was a good wind velocity to distribute them, we might have taken some chances ..." They monitored the wind and would generally not release radiation if the conditions did not dilute the plume enough. Wakefield Wright, a chemical operations supervisor, has stated: "before you could dissolve in those days you had to worry about wind conditions ... They didn't want the wind to be in the direction of Tricities although they were 30 to 35 miles away. If we started dissolving and the wind got bad, we had to quit."

If the officials had taken these precautions, then why did they allow radioactivity releases which violated their own guidelines? From the available documents, it appears that even with all their precautions, they discovered that they could not obtain enough plutonium while operating the facilities safely. Even though Japan had surrendered and the war was over and there was no other nation which possessed atomic weapons, the government felt that they had to have more bombs. Therefore, the officials continued to operate the plants in ways they knew were dangerous anil decided that the public could not be told the truth. They adopted deception as government policy.

How Did Hanford Cover It Up

In one word, by lying. A 1955 address by Hartford's chief health official H.M.Parker to a United Nations meeting on the peaceful uses of atomic energy, held in Geneva, provides an excellent example of how Hanford deceived the world. In the course of his talk, Parker mentioned "a single emission of 100 curies of iodine-131 in a few hours". The declassified documents now show that the actual amount released was nearly 80 times more than his version. In a similar vein, Parker also. talked about another release of 100 curies of radioactive particle, which was carried off-aite. What Parker did not tell his distinguished audience, was the fact that the it was ruthenium (a longer lived radionuclide) that was being released, it traveled further than Spokane (more than 125 miles downwind) and the actual release amount was 360 curies.

Security: The Culture of Secrecy

During World War II, Hanford "was such a hush-hush operation that even the amount of ice cream consumed by the workers was classified " At the start of the Manhattan Project. the military adopted a security system known as compurtmen-Uiligation. Individuals would only be told what was necessary to perform their tasks. Parker wrote that security could be maintained "if hazand *infonnation is phrased in such a manner thai the maximum information on the nature of the hazaed is combined with the minimum infonnation on the nature of the materials used and the processes uneolved."*

The culture of secrecy was nearly a total preoccupation with Hanford workers and their families. The Federal Bureau of Investigation (FBI) maintained an ominous presence in the workplace* and in the neighbourhoods of Hanford workers. One worker commented, "There have been cases of men talking or telling their wives more than they should. There are a lot of FBI men working in the areas. We all know when a guy starts getting careless, and it isn't very long until he is not around any more." To share concerns about Hanford's operations meant dismissal and ostracism.

Public Relations: The "Suppress Officer"

Milt Cydell, Hanford's public relations officer during and after World War II, was commonly referred to as the "suppress officer".

When the first atomic bomb was dropped on Hiroshima and the

workers at Hartford learned about the nature of their work, the rumour mill went into high gear. Harry Petcher, a food service worker at Hanford during World War II recalled "When the bombs were dropped my recollection was, God, is that what we were doing here? Did we get poisoned?" Hanford officials worked quickly to reassure the workers that building the bombs was safe.

Depending upon their audience and message, Hanford officials changed their tune. Writing two weeks after the atomic bombings, Parker and another key health official, Dr Simeon Cantril, wrote a memo to the workers stating that "we don't want any misinformation by the misinformed to mar either our record or the morale we have built up through confidence in the safety of our operations." In answer to concerns about Hanford's effect on the public living near Hanford, Parker and Cantril calmed the workers by stating: *"The amounts of radioactive iodine in Richland are entirely innocuous."* Less than three years later, the same Parker, writing an internal memo, would refer to the "entirely innocuous" levels of iodine as being high enough to have caused "concern in 1945." A year later in another internal memo, Parker made another reference to the "entirely innocuous" levels of iodine: "In *1945 iodine1945 contamination of vegetation was 45 to 70 times accepted permissible maximum at Richland and Kennewick."*

Medical:
A Profusion off Sad Stories

On June 9, 1952, Ernest Johnson died in his Richland home after becoming ill at work. He was a mamtenance foreman at one of the plutonium production reactors at • Hanford. He had not been feeling well that day and seen his doctor in the afternoon. As the funeral home prepared Johnson's body, several suspicious marks were discovered on his skin. Knowing that he had worked at Hanford, the funeral home called the General Electric medical department. (General Electric Company were the operators of Hanford under government contract.-Editor)Because the injury could have been connected to Johnson's work, G.E. decided that an autopsy should be done but not by its own pathologist. Dr Frederic Davis, the pathologist for Walla Walla, was called to perform the autopsy. Davis was assisted by three Hanford (G.E.) physicians. The cause of death was listed as ruptured aorta near the heart. Johnson had a history of high blood pressure. The autopsy report could not explain the marks on his skin.

Johnson's widow, Marie, was suspicious of how he had died. Some of his co-workers had told her that her husband had been heavily exposed to radiation in the months leading up to his death. (The official Hanford records do not indicate this high exposure.) When Marie took her husband's body back to Chicago for burial, she had a second autopsy done. This time the autopsy surgeon considered the burn marks to be the result of radiation exposure. Marie Johnson began the process of filing a claim, contending that on the work radiation burns had contributed to Johnson's death.

The Atomic Energy Commission (AEC) refused to consider the possibility and organized a team of its own medical and legal experts to travel to Chicago in an attempt to get Dr Thomas Carter, who performed the second autopsy, to alter his opinion and not find radiation as the cause of Johnson's death. He was even threatened with legal action if he did not change his opinion. However, despite all the threats, Dr Carter remained steadfast. Having failed to move Carter, AEC felt compelled to discredit his testimony. In order to do this, the AEC arranged to have an "unbiased" review done of both the autopsy reports. However, AEC manipulated to have Dr Simeon Cantril, as the third and decisive referee. However, Cantril was far from unbiased. He was an AEC consultant since 1943, and was also the person who had helped in the preparation of the first autopsy report. The state of Washington accepted the findings of this review and denied Marie Johnson's claim.

Eighteen months after Ernest Johnson's death, Hanford official Dr W.D.Norwood claimed to a Seattle newspaper, "*We have never to our knowledge, had any sickness due to radiation..."*

Legal:
Defense in Depth

The documents show that from the very beginning, Hanford was aware that people would file legal claims when they found out what Hanford produced. In February 1945, Colonel Franklin Matthais, Hanford's wartime commander, wrote in his diary that he "inspected the meteorological and radiation monitoring setup and the recordings that are being taken to permit us to be prepared in case of claimed serious exposure in certain areas." He made the following noting in his diary on July 6, 1945 "I asked him to set up some procedure that would assure us of getting first information on any question that might lead to a legal claim." Mattias' paranoia regarding people suing Hanford went so far as to require a shepherd to sign a waiver before being allowed to herd his sheep to pasture near Hanford. He also asked state and federal government officials to sign secrecy oaths.

Science:
The Complicity of Silence

The hazards at Hanford were not a complete secret for many in the scientific community. At various times, the government set up consultative groups, made up of acien-

tists and officials from private businesses, industry and the universities. To the Hanford management, their role was purely public relations.

This consultation with outside "independent" experts does present an apparent problem: if there was anything really dangerous about Hanford, wouldn't these outside scientists have alerted the public? Most of the people on these advisory committees were from companies that either had or wanted AEC contracts. The scientists knew that as long as they kept supporting the party line that the radiation being released posed no harm, they could keep their position and professional reputation. When certain conscientious scientists violated this cozy arrangement by asking too many questions or by coming to different conclusions, the establishment would launch, a campaign to discredit them—the isolated individual verses the established order. The experiences of many former AEC experts like *Dr* John Gofman are well documented.

Environmental monitoring reports are models of scientific deception. From 1946 to 1957 they were issued quarterly, but access was strictly limited to those people.who had the proper security clearances. In 1958, the quarterly reports were converted into annual reports and issued as unclassified documents. However, all detailed information available in previous years, became only general information about environmental impact.

Another way in which scientific deception was practiced was by changing the places from where samples were collected. Even when the monitoring reports were classified as 'secret', officials were careful not to report the worst news. During the fifties, as more reactors were added along the Columbia river, the radioactive concentration the river water increased several-fold. Until 1954, the quarterly reports included three readings-one along the north bank, one in the middle of the river and another on the south bank. Due to a channeling effect in the river, the south bank usually gave a reading 2 or 3 times higher than the north bank reading. Starting in 1955, the quarterly reports only mention one Hanford reading, and it is obvious that the lower north bank reading is being used.

Another method used to obfuscate reality concerns the various assumptions used in calculation radiation exposure estimates. For example, in the fifties there was much concern over the radioactivity in whitefish in the Columbia. Compared with other species, whitefish concentrates more radioactive phosphorus, which was one of the key components of the radioactive effluents from Hanford. From 1959-64, Hanford reported doses to the bone from phosphor us-32 for an "average" individual; and from 1964 to 1966 for a "maximum" individual. What is intriguing is that while the "average" person ate much less fish than the "maximum" (10-25 pounds was considered average, 90 pounds for the maximum), the "average" person caught his/her fish in water that was more heavily contaminated. Hanford placed the fishing hole for the "average" person at the point of nearest approach to the reactors whereas the fishing point for the "maximum" individual was placed further downstream where the radiation is diluted by another two rivets joining Columbia.

The Deception Continues

Most of this article has focused on the deception during Hanford's first twenty years for which there is more information available. But the policy of deception has continued right up till the present.

Jim Thomas
HEAL Perspective 10 -11
Summer/Fall 1992

World Uranium Hearing and IInd Global Radiation Victims Conference

In September '92, two important antinuclear meetings took place. The World Uranium Hearing held in Salzburg, Austria from September 13th to 19th. and the IInd Global Radiation Victims Conference, held in Berlin from September 21 to 20. Both the conferences aimed at bringing together people who have been a fleeted by all aspects of the nuclear fuel cycle and weapon's testing—often indigenous people—and activists and more academically oriented "experts". The World Uranium Hearing was actually set upas a series of "hearings" at which "witnesses" gave testimony to a board of "listeners", while the Global Radiation Victims Conference was a more conventional sort of a conference.

I was lucky enough to be invited to attend both events and a subsequent speaking tour arranged by the World Uranium Hearing at different places in Germany, Others from Australia included activists

from Melbourne and a group of aboriginal people from Maralinga, where the British tested nuclear weapons in 1960s.

The World Uranium Hearing was a high-profile event designed primarily to focus attention on the affect uranium mining has had on the indigenous people worldwide, though its concerns were not limited either to indigenous people or to uranium mining. There were testimonies from non-indigenous activists such as myself and from 'experts' with specific knowledge of particular aspects of the nuclear fuel cycle and weapon's testing programmes.

Nevertheless, the emphasis was on indigenous people. Testimony was received from American Indians, Canadian Inuit (Eskimo), Kazakhs, People from Chupotka and Novaya Zemlya in the CIS, Peru and Brazil and from small Pacific Islanders, Australian aboriginals and from India. India was represented by people from Meghalaya and Jaduguda in Bihar and Dr Dhirendra Sharma from Delhi.

The World Uranium Hearing was an occasion to be remembered. It was extraordinarily well-funded for an environmental gathering with solid support from the city government of Salzburg, as well as the provincial and national governments. The proceedings themselves were at the old university in the medieval centre of Salzburg, while meals were had in the new residency palace('new' here means 16th century), under chandeliers with chubby baroque angels flying overhead.

But it was memorable for far more than the setting. It brought home to an Australian activist the very resl nature of the problems and the suffering caused by the nuclear experiment.

An example: As the conference drew to a close, it transpired that we were to be taken to the slopes of Grssblockner, the highest mountain in Austria, for the final act. When we were taken there, it was in the most expensive-looking, hi-tech tourist buses that I have ever seen, let alone traveled in. (Let us leave aside for a moment the fact that one of our hi-tech buses broke down due to a subtle software malfunction). Who, I wondered paid for these buses? It turned out that the bus company is giving us this ride for free. Why are they doing that? Well, they are in the business of taking people up to the snow... and in May 1986, after the Chernobyl accident, the snow was 100 times as radioactive as is considered 'safe' for people, and the company suffered badly. Now, the proprietor is thoroughly opposed to nuclear power. There were many other small examples like this.

But what created the most impact at the hearing, were the testimonies themselves. There were stories of heroic and successful resistance and there were stories of prolonged deep suffering.

Joan Scottie, an Inuit from Baker Lake in the frozen arctic north of Canada, gave an inspiring account of her community's successful (so far) resistance to the establishment of a massive new uranium mining project at Kiggavik by the German company Urangesselschail.

A variety of American Indian representatives told of the effects on their people of living on lands by the side of the tailings piles of many now defunct uranium mines, and of the so far very feeble efforts by the U.S. government at cleanup.

People from Novaya Zemlya gave an impassioned account of the Soviet and now Russian government's persistence in using their ancestral hunting grounds as a place to conduct nuclear testing.

One thing that came across very clearly to me was that there seems to be some mysterious link between peoples' social and political status and their geology that makes the land of indigenous people uniquely suitable for uranium mining, as a site for nuclear power plant, for nuclear waste disposal and for nuclear weapons' testing. The truth of course is, that governments think indigenous people as simply expendable. People who can be quite literally bulldozed or cheated into accepting almost anything. The same treatment meted out to say, residents of Paris, or Moscow or Delhi or Sydney instead of Tahiti or Novaya Zemlya or Maralinga or Meghalaya, would provoke a political crisis that would terminate the programme.

Research and lobbying in Australia just doesn't prepare one for the sheer emotional impact of all these real life stories, and often my wife Mishka and I were moved to teare. We weren't expecting to hear such tales of prolonged, intense, and wholly avoidable human suffering, not only from the indigenous victims of the nuclear industry but also from many who had once worked in it.

An example of this was the testimony given by a worker from the U.S. weapons' industry, who described the effects on his health. Here a large part of the pain came not only from the sickness caused by radiation exposure, but also from the years of being lied to, by his employers and government.

The crowing example of an industry insider-Victim' came in the inspiring testimony given by Vladimir Chernousenko. Chernousenko is the person who led and supervised the clean-up effort at Chernobyl. He is presently dying from the radiation exposure he received while doing his duty in constructing the sarcophagus at Chernobyl. He subsequently wrote a number of articles and a book giving a highly critical insider's view of the Soviet/C.I.S, nuclear industry. For him, fighting

the industry is a race against the effects of radiation on his own body.

Evidence from India came from activists from Meghalaya and Bihar.

Mr Hoppingstone Lyngdoh and Rev. Basaiawmoitof the Khasi Jaintia Environment Protection Council spoke about the new plans for uranium mining in Meghalaya, Mr Xavier Dias and Mr Areeparampil spoke about the impact of uranium mining in Singhbhum district of Bihar. Besides, there was Dr Dhirendra Sharma from Delhi.

At the conference in Berlin, there were reports from many scientists, including Dr Alice Stewart and Dr Rosalie Bertell and Professor E.T.Sternglass amongst others. The Berlin conference was dominated to some extent by the large contingent from C.I.S. who gave reports on the effects of Chernobyl and of the nuclear bomb testing at Semipalatinsk in Kazakhstan. However, many of them were somewhat 'establishment' and often talked all around the subject instead of being straightforward.

A few questions do hover around the conference. World Uranium Hearing spent $15 million on its delegates[1] travel, accommodation, and food, plus faxes, phones, translations, photocopying, etc, Was it money well spent? $1*5 million, I believe, will certainly stop uranium mining in Australia. It would do much to stop the world-wide spread of nuclear industry, if farmed out to grassroots activist groups. However, it is a fact that this money was forthcoming for the World Uranium Hearing, but not otherwise. And, also that the Hearing did make an impact on the mainstream media.

Towards the end of the hearing, the Uranium Institute issued a 'brief* ing', in which it tried to detail all the 'benefits' of uranium mining to local communities. This briefing seemed very incongruous after the whole week had been spent listening to the 'beneficiaries' talk detailing suffering.

Finally, it must be said, that the indigenous people brought to both the conferences a deep spirituality and a holistic value system that contrasted very sharply with the institutional values of power and money. We will need these values as well as the hard data that we have had for years if we are to win the war against nuclear power and its fuel cycle.

John HaIlam
Friends of Earth
Sydney

Petra Kelly: World Citizen

First a letter from a friend:

No, it cannot be suicide. Petra Kelly and General 'Bastian were people who stood and worked for a cause, against odds, on issues most others would not take a stand or get involved in* They were concerned at the growing arms trade, the nuclear industry, industrial pollution and the problems of refugees, especially the Tibetians.

At our first meeting, Petra Kelly had personally come down to identify and take me inside to her office next to the German Parliament in Bonn, as the guards would not let me in, without my passport for identification.

In November 1988, when we were participants at the Nehru Centenary Conference on Nuclear Weapons-Free and a Non-Violent World in New Delhi, she had quickly obtained an appointment with Rajiv Gandhi at the lunch hosted by the late PM. One of the issues they had discussed during the more than 45 minutes discussion had been the nuclear industiy, especially the fast breeder reactors. That evening both General Bastian and Petra Kelly had told me that Rajiv Gandhi seemed concerned and wanted more information.

Petra had expressed her concern at the consequences of German unification. When she had lost her seat in Parliament, she had sent a letter introducing us to her successor in Parliament, from the former Eastern Germany. She was simple, easily approachable and a dear friend to all concerned people around the world.

The Environment and Peace Movements have lost two great friends.

Hemchandra Basappa
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Death of Petra Kelly is a great shock. She was like a shooting star- a briIIiant burst of light in the night sky. Anumukti pays tribute to this world citizen by reproducing bits from her writings.

A Power Shared With Others

As we once thought of the physical world as separate bodies, acting on one another primarily by collision, so we thought of the social world, too, as changed only by coercive forces.

Many of our resources have to do with our own daily life, with e way in which we live, with the way in which we change ourselves. The tradition within the peace movement of seeking to live one's politics and attempting to move one's life into closer accord with the values of non-exploitation, liberation, freedom equality and mutual aid are the most important elements in disarming and in creating peace around us....

The depth of our own change cannot happen in one single day, this change must be renewed every day and continue all the rest of our life.

We are looking for a new power, powershared with others, not power exercised to gain control over them. Feminism, ecology and non-violence belong together and are interrelated. But at the same time, we must be watchful that, while we struggle together against the big war, the little war in our everyday life is not forgotten — the little war being waged against the weak, the handicapped, the elderly, against children and women. All of us must be concerned with both levels: the big and the little war waged against us as individuals, against smaller countries, against the planetary environment, every single day. Resistance to war, to the use of nuclear weapons and nuclear energy is impossible without resistance to sexism, to racism, to imperialism, and to violence as an every day pervasive reality. There is a very profound relationship between the fact that many women and children are commonly attacked, beaten up, and raped, and that a nuclear war as well as a nuclear catastrophe threatens this entire planet Earth, which has no emergency exit.

UNPO (Unrepresented Nations and People's Organisation represents minority groups, indigenous peoples, and occupied territories not officially recognized by the United Nations. From their reports on human rights violations, it is evident that Western governments in particular and Western people in general have little or no awareness of the continued extinction of indigenous peoples. In over half the countries of the world, people are detained or imprisoned without trial; tortured or even executed for their race, gender, cultural, religious, social and environmental beliefs; and for their protest through non-violent means.

Human rights and environmental issues are and must be inextricably linked. "Without respect for people, people will have no respect for other species. Without an equitable and ecologically sustainable distribution of the world's wealth, there are no ecologically sustainable societies."

The ecological movements and the green parties must work towards advancing human rights in a far more radical way than has been the case, there is much to learn from indigenous societies, which have a harmonious relationship with land and nature, and simple lifestyles which offer models of what alternative and ecological societies could look like.

And What About Our BAnd What About Our Bomb?

Recent reports in the press have highlighted Pakistani efforts at acquiring a nuclear weapons capability, following the showing of a documentary film in the U.S. In this report we examine the some of the work being done in India in the same Held. The report is excerpted from a long article by David Albright and Mark Hibbs which appeared in the September 1992 issue of *The Bulletin of Atomic Scientists.* The May issue of the same journal carries a long article on the Pakistani bomb efforts. We shall in future be printing news regarding the Pakistani nuclear programme more regularly in Anumukti.

The "Peaceful" Explosion

No one has questioned India's ability to build atomic bon\bs since 1974, when it detonated a 12 kiloton "peaceful" nuclear explosive in the Rajasthan desert. Although Indian officials claimed the explosion was geared toward exploring such things as enhanced mining techniques and underground engineering tasks, it was clearly intended to develop a weapons' capability. Raja Ramanna said in his recently published autobiography that participating "in the development of a prototype weapon lent me a special status."

The plutonium for the 1974 test was produced at BARC in the Cirus research reactor, a 40 MW reactor supplied by Canada that began operating in 1960. This reactor can produce about 9 to 10 kilogrammes of weapon-grade plutonium a year.

Canada supplied the Cirus on condition that it be used for peaceful purposes only, but Canada did not require International Atomic Energy Agency (IAEA) safeguards on the reactor or an accounting of the amount of plutonium the reactor produced. India claims that its agreement with Canada did not preclude the use of Cirus produced plutonium for "peaceful" nuclear explosions.

The Cirus plutonium was chemically separated from the irradiated uranium fuel in the nearby Trombay plutonium separation plant, which began operation in 1964. Currently most of India's supply of weapons plutonium is believed to have been produced in the Dhruva reactor and separated at Trombay, with only a small amount of high quality plutonium produced in unsafeguarded power reactors and separated at Tarapur.

India is estimated to have an inventory of about 290 kg of plutonium available for manufacture of nuclear weapons by the end of 1991. Based on the Department of Atomic Energy's annual reports we believe, that almost all of this plutonium is in separated for

In the absence of information about the amount of plutonium needed for an Indian bomb, we assume it to be about 6 kilogrammes, a higher than normal value. Thus India has enough plutonium for at least 50 bombs.

Uranium Enrichment

Till as late as 1988, DAE had been denying that it had built a new uranium enrichment facility at Ratnahalli near Mysore? Now, in an interview, Dr P.K.Iyengar, director of Department of Atomic Energy (DAE) told Nucleonics Week that while India had successfully operated a 100-machine centrifuge cascade at Bhabha Atomic Research Centre by 1985 itself, we built the new facility to further develop the technology,"

Well placed Indian sources said that the Ratnahalli facility was not included in the list of nuclear facilities recently given by the Indian government to Pakistan, and that Pakistan, convinced that India had built a second centrifuge plant, had registered its objections in New Delhi after the two countries exchanged lists.

According to sources, construction of the Ratnahalli facility already underway in 1987, was subject to delays and took about four years to complete. One western official said production of enriched uranium product at Karnataka was "very recent" and likely began no earlier than mid-1990.

The enrichment programme could be part of a long term programme to build thermo-nuclear weapons. Though these weapons rely on the fusion of hydrogen (deuterium and tritium) for most of their explosive yield, the process is started by atomic blasts. Although plutonium or weapons grade uranium is used in the "primary", which provides the initial blast, only weapons grade enriched uranium can be so located with the thermonuclear fuel to provide an extra "kick" to get the fusion reaction going.

Advanced Fission Designs

Although India has reiterated that it has not built or deployed nuclear weapons since 1974, it has maintained and expanded the complex of laboratory and industrial support activities essential to a nuclear weapons programme. Because India has made progress in fissile materials production and processing, and in the production of other important materials, it is believed to have designed nuclear devices that are smaller, lighter and more dependable. One U.S. official said that India is continuing to do more research on design than Pakistan.

One indication of Indian aspirations in advanced designs is BARC's interest in beryllium metal. The use of beryllium makes possible the design of smaller, lighter and more advanced nuclear weapons. The minimum amount of plutonium *or* highly enriched uranium required to sustain a chain reaction or "critical mass "can be reduced by surrounding the core with a neutron reflector, and beryllium metal is hard to forge and cast, and hot-pressing creates higher quality parts.

Boosted and thermonuclear weapons

India also makes tritium, which means that it could be exploring tritium based neutron emitters or tritium boosted fission weapons. Weapons experts however, believe that the development of boosted weapons would require full scale tests.

Although Indian officials have denied trying to manufacture an H-bomb, indirect indications of such a programme include lithium 6 purification and production, and an extensive inertiaI confinement fusion (1CF) programme at BARC. An ICF facility would be useful in the study of the high-energy, high density physics associated with thermonuclear explosions, the improvement of elaborate weapons design computer codes, and the development of sophisticated diagnostic techniques and instrumentation.

Dellvery

In addition to combat aircraft able to deliver nuclear weapons, India is developing nuclear capable missiles. Agni can carry a pay load of 500 to 1000 kilogrammes *over* a . .rango of 1,000 to 1,500 kilometers. This missile is large enough to hold a nuclear warhead and reach targets in China *or* Pakistan.

The economic and political costs of a decision to move forward on these weapons could be high. Besides draining valuable resources needed for economic development, deploying a nuclear arsenal would lead to Chinese and Pakistani countermeasuree. In the long run, India's security would be reduced.

David Albright and Mark Hibbs

Nuclear India: A Dream Gone Sour

This film is a powerful inducement of India's nuclear programme. Some of its images, especially of deformed children-touched me greatly. For the last two years, I have personally known the plight and misery of some of these children. I have not been able to make any difference in their wretched existence. Therefore, a film which would make this awful condition known to the whole world and hopefully force our ruling class out of its uncaring caccoon should have been a source of some satisfaction. Unfortunately, this is not the right film to bring justice to the victims of our nuclear madness.

The reason why, inspite of its strong visuals the film fails is because it is based on a fundamentally flawed concept. It seems to say two things, both of them wrong. One, that if the "rules" are properly followed, then nuclear power can be run 'safely', and two that nuclear enteiprise in India has failed because it is being carried out in India—this poor benighted land where people know no better than to drink water from leaks in radioactive effluent carrying pipelines and farmers are still ploughing their fields using hand held ploughs. The film glosses over the fact that nuclear enterprise has been a total disaster everywhere. Thus, we see the stereotype images of a bullock cart moving in the foreground, with the nuclear power plants forming the background. The commentary rubs this in with that if the same level of radioactivity as observed on the beach sands of Kerala were to be observed in Britain, it would mean immediate evacuation. While this may be true, the impression that the British nuclear programme is somehow safer or less dirty is not. Nobody is in a better position to appreciate this fact, then the maker of the film, James Cutler, who was the person who exposed the dirty linen of Sellafield.

The film is wrong on another count. It makes a great point of saying that the film was made clandestinely. This point is emphasised more than once, and is mentioned in connection with the all pervading secrecy surrounding the nuclear programme in India. I do believe that the Indian nuclear establishment would not have allowed the film to be made. But I also think that neither did the producers make any attempt to do so It would have been better if they would have shown the same discretion in their presentation that they showed in filming.

The Indian nuclear programme is, in reality, a dream gone sour. The people living near nuclear establishments are not its only victims. We all are. We are saddled with a power source that does not, will not and cannot deliver the goods. Only the bads. The film with fine depiction of the contrasts between government claims and the reality on the ground does make one think. Unfortunately, its tone, is apt to raise one's patriotic hackles. This is a pity, since the major issue should have been one of social justice to the victims.

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ANUMUKTI

A Journal Devoted to Non-Nuclear India

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The Worst Danger

Labour's exploitation is not the worst danger,
Police beating is not the worst danger,
Greed and betrayal of trust are not the worst dangers,
...The worst danger is to be overwhelmed
by the peace of the grave
To lose one's capacity to react with sensitivity,
accept everything quietly,
to leave home for work, and then return home from work,
The end of our dreams
This is the worst danger.
The worst danger is that eye
which sees yet coldly ignores everything.
Whose sight loses the capacity to kiss the world with love and
which is lost in the blinding stream of happenings...
The worst danger is the moon,
which after every massacre rises in the quietened courtyards
But does not dig in your eyes like hot chillies,

Struggle will bring
beautiful designs for the embroidery of our sisters,
struggle will appear
as milk in the breasts of our wives,
struggle will become
glasses for the eyes of our old mothers,
struggle will smile
as a flower on the graves of our dead.

Avtar Singh Posh
(Translated prom Punjabi)

From The Editor's Desk

Anumukti in the Time of Troubles

The last few months have been a terrible time; a time when everything seemed topsy-turvy; a time when all of us appeared to have given way to a collective frenzy; a time when reason was lost and an irrational rage and fear reigned everywhere. A time to be ashamed of.

And yet as Dickens said of another turbulent era, "it was the worst of times, it was the best of times."... Shining like jewels in a sea of horror are innumerable stories of courage and sacrifice. People like Jamu Behn in Rander, Surat who single-handedly stared down a large crowd and saved four of her neighbours; or of the muslim brother whose neighbour a Hindu grocer ran away to save himself from mob-fury alter handing him the keys of his shop; this man proceeded to open the shop and sell goods and after peace was restored and his neighbour returned, restored to him, the entire proceeds. Or the Muslim girl who refused to accept the nasty circumstances that her friend would not be able to appear in examinations since the school they both went to was located in a muslim area; and who therefore went to her friend's house alone at a time of tension to invite her to come and live in her house. The parents of the Hindu girl were apprehensive and asked the Muslim girl to come back with her father. Well, the father accompanied his daughter back and assured the family that they had nothing to fear and could safely send their daughter to his home; and now both of them were living together in a Muslim home and preparing for their exams... Stories of Hindus saving Muslims, Muslims saving Hindus. No, I am putting things badly. They are tales of ordinary people exhibiting extraordinay courage to save fellow human beings.

Chandrashekhar, one of my students, raised a question that continues to bother me. The whole country is burning, he said, and yet you continue to talk about nuclear energy. The question of communal harmony is more vital. We should quit everything else and try our best to restore sanity.

No doubt communal harmony is vital. But then does sanity mean just the mere absence of communal or other civil strife? Does it not mean a striving for a just society where irrational schemes like nuclear power and large dams and military and the like are impossible? The major sites of the current bout of madness have been large industrial cities like Bombay, Surat, Ahemdabad, Calcutta, Kanpur... Places where a vast rootless underclass is forced to live in inhuman conditions just to eke out a living. The roots of continuing violence are not basically religious but are actually related to the disorientation and dehumanization caused by this monster of development and the idea of a'hard' STATE. There is the builder lobby setting fire to slums so that they can get hold of the land. There are the goondas trying to terrorize and extort 'protection money'. There are the politicians who are thinking of the next elections and how all this fear and hatred is going to come handy then. And there are 'decent' middle class families who are sick of all this rioting but who have in the past been so engrossed with themselves that they have not bothered to share their joys and sorrows with their neighbours and in fact don't even know who their less well off neighbours are. And isn't combating all this, what *Anumukti* is all about?

However, the bold declarations need to be tempered by a dose of realism. The disruption caused by the riots, and more especially the uncertainty, has been a great hindrance. The greatest problem has been the mails. For a whole month since December 6, we did not receive any mail at all, and after that it has been somewhat sketchy. I have started realising what isolation means.

Our printing schedule is no longer a schedule. It is a joke. To get back to some semblance of regularity, we plan to bring out two issues together. Unfortunately, there is no way for us to know if you are receiving the issues or are the mails just as bad at your end. So if you do get this issue could you please drop us a line and let us know that order has returned to our land.

Three Cheers for Clinton's Budget Proposals

President Clinton in his "State of the Union Speech", came up with some very fine proposals which ought to be emulated by our finance minister. Most praiseworthy was the idea that one cannot go on increasing the national debt. It is time that one said enough is enough and took solid measures to curb the debt. Clinton found 150 'useless' public spending programmes. I am sure we can find more. One of the programmes that Clinton found useless and unworthy of government support was research and development *of nuclear power.* Is Narasimha Rao listening?

"The Way of Science is to Seek the Truth"

A Reappraisal of India's Cloak and Dagger Nuclear Policy

In the last issue of Anumukti, we had reviewed a video film "Nuclear India: A Dream Gone Sour" which had been shown recently on British television. This article by Anthony Tucker, the former science editor of The Guardian is a serious reevaluation of the Indian nuclear programme in the light of experience. It appeared in The Pioneer from New Delhi on January 29, 1993. It is heartening to note that such a reappraisal of the Indian nuclear programme is taking place all over the world. It is a pity that Indian nucleocrats are yet immune to world currents.

1 Europe and in North America, even before Chernobyl, the cocoon of secrecy and public deception that, from the outset, surrounded and protected nuclear power programmes had been systematically stripped away. It took two decades of investigation by the media, of activity by peaceful truth-seeking organisations like Pugwash, noisy activity by antinuclear protest groups, agonising reappraisal by Governments and the self sacrifice of a handful of courageous whistle-blowers — all of whom knew that they could expect to be treated savagely, as indeed many were.

Yet the nuclear industry, even where shown to be uneconomic, technically unjustifiable or socially irresponsible, its continuing nuclear weapons link publicly exposed, still interprets criticism as unpatriotic hostility and seeks to confound or obfuscate any evidence that might damage its former image. Even in the United States, where nuclear power is effectively dead and investigators have the advantage of a Freedom of Information Act, the industry continues to defend its last niches of secrecy irrespective of the fact that these often have direct relevance to worker and public health. It is as if the nuclear industry still believes itself to operate by divine right, without any need to be publicly responsible.

Thus, even in the wake of Chernobyl and in countries whose political systems require Parliamentary accountability, the unraveling of nuclear power programmes has only slowly revealed the extent to which they have obstructed investigation and minimised problems while dominating and unbalancing national energy investment programmes. Every national nuclear programme has rested, often to a great extent, on information manipulation, on the imposition of arbitrary secrecy, and on systematic public deception on matters of cost, technical achievement and promise. Worst of all, because of the huge costs of commitment, programmes have in many countries evaded public criticism by the concealment or understatement of health, engineering and environmental problems. India is not alone in this nuclear trap: the difference between the situation in India and that of Europe and United States, is that in India the cocoon of concealment remains dangerously intact.

This message emerges repeatedly in "Nuclear India: a Dream gone sour" screened by British Independent Television in September. Of course, it was compiled clandestinely for, under the rule of secrecy imposed by the Indian Government, **it** could be compiled in no other way. Inevitably it has infuriated **the** Nuclear authorities

in India elsewhere and, since it presents a short, simple and fragmentary account, it is not free of error. Nuclear hawks will pick at it voraciously.

They will say, for example, that single measurements of high gamma radiation do not prove serious contamination, and that anecdotal evidence of malpractice in radiation monitoring does not prow failure in health physics control. Further, neither cases of workers with chest and back keloids nor the fact that some villagers near nuclear planus have a high incidence of genetic malformations, necessarily demonstrate causal connections with the nuclear power programme. Hut when all these factors recur and combine in a single investigation around nuclear sites, the circumstantial evidence of malpractice becomes compelling, if not overwhelming.

To those with knowledge of radiation protection standards, of health physics, of worker and public epidemiology, the evidence implies serious failures in duty of care and unforgivable laxity by the Indian nuclear authorities in many sectors of management and control. This is a terrible indictment, made more terrible in the programme because it seems that the nuclear authorities in India may be deliberately exploiting the profound ignorance of radiation hazards among workers and villagers.

This indictment would have dismayed and sickened the pioneers of the Indian nuclear programme. Dr Bhabha was open and proud about what India was doing. Evidence of profound health effects would have prompted him to ask for open investigation

This indictment would, I am sure, have dismayed and sickened the scientific pioneers of the Indian nuclear programme. We need to remember that they were driven by the purest of ideals. Some who read this may have talked long and quietly with Homi J Bhabha on the slopes above Trombay in 1960s, as I did when the Indian nuclear dream was being born out of incredible difficulties. India presented a peaceful face but everyone knew, even then, that an important political and defence requirement was a route to nuclear weapons.

Not everyone realised that India could have taken the alternative route to weapons of uranium enrichment-a route which needs no civil nuclear power programme as a cloak off peace. South Africa has taken this route and, inevitably, India also now has this additional weapons technology. Thus there is no longer a unique military imperative behind the Indian civil nuclear power programme. It should be judged solely on its civil achievements, economics and hazards.

Of course, historically it matters that the dream of nuclear pioneers required a true balance between future civil and military needs in India. But Dr Bhabha demanded, and initially possessed, not only impeccable technology, but management and control powerfully insulated against political pressures. Everything, he said, would be dedicated to achieving industrial, social and national benefits while minimising any adverse impacts. He chose the plutonium route based on the inherently 'safe' Candu reactor technology-and a completely internalised fuel cycle with both uranium and thorium in mind-for reasons that seemed morally and technically irrefutable at the time. The dream died the moment it was dispossessed of its political independence.

That India's nuclear pioneers, along with many other countries, were deceived in their beliefs of low cost electricity and great social benefits, is an observation of hindsight. The central point is that, as a great scientist, Homi Bhabha was open and extremely proud about what India was doing and why it had to be done.

It follows that evidence of concealment of profound health problems in and around India's nuclear plants, would have sought urgent and open investigation. The way of science, he would say, like that of all honest men, is to seek the truth.

No country that perceives itself to be under nuclear threat will voluntarily abandon its own nuclear weapons programme although, in time good will and diplomacy will surely find routes towards nuclear weapons-free zones. Nor can any programme involving enormous investment of national resources be halted overnight. Changes of direction are especially difficult if a Government is in the grip of self seeking advisers whose role is to reinforce and expand, by every means, commitment to existing policy, irrespective of its true worth to the nation.

However, misdirection may all too easily become evil in situations where informed criticism is silenced by secrecy law, and where academics and representatives — however intellectually honest in principle — are manipulated by Government control of their financial support and tenure. In such situations the intellectual fabric of society becomes so corrupted and enfeebled that the outcome is likely to be disastrous, economically, technically and socially.

Recent history tells us of the tragic speed with which economic and social disorientation can overtake a major power suffering from suppression of criticism, with its associated self-de-

caption and enfeeblement and impairment of judgment. Chernobyl was as much a symptom of this sickness as an avoidable international disaster (and a demonstration of the inadequate powers of the International Atomic Energy Agency). One way or another the truth about the failure and mismanagement of nuclear technology — and about defects in the scientific, technological or medical fabrics that permit mismanagement— will emerge.

What can and what should India do now that its nuclear programme is under the spotlight of international concern and seemingly grossly flawed? First, she must have the courage to investigate openly, perhaps through the WHO environment arm. If things are awry, she must put them right. Remember, too, that wherever civil nuclear power has come under open economic and safety scrutiny, it has been found to be excessively expensive, unacceptably hazardous, or both. Open societies are only just recognising and taking seriously the health, waste, investment distortion and other burdens imposed by their once much-wanted nuclear programmes.

India's nuclear problems may prove ingrained and intractable, but the country has great richness of skills and many other energy options. Hydro and other benign sources await proper investment together with the deeper involvement for her world level physicists, chemists and engineers. Even if nuclear-related health problems can be adequately controlled, nuctear's outrageous resource demands are themselves a potentially lethal ailment for the nation. Socially crucial opportunities are being missed. Surely Bhopal should have taught India that concealment offers no solution to health, technical or political problems.

Anthony Tucker The Pioneer

Changes of direction are especially difficult if a Government is in the grip of self seeking advisers whose role is to reinforce and expand, by every means, commitment to existing policy, irrespective of its true worth to the nation.

Editor's Note:

I would like to add just a few comments to this article, which expresses *the Anumukti* position rather well. The first is an observation. The immediate reliction of the nuclear establishment to the recent disclosures of radioactivity leaks from Bhabha Atomic Research Centre, and the general rise in newspaper scepticism regarding Department of Atomic Energy handouts has been to propose changes in the already draconian and infamous Atomic Energy Act of 1962. The new amendment makes it unnecessary for the nuclear authorities to obtain the Attorney General's permission before prosecution. Doesn't this remind one of *"the intellectual fabric of society becomes so corrupted and enfeebled that the outcome is likely to be disastrous...."*

Apropos the suggestion in the article regarding investigation of health problems through WHO, I feel that there is no dearth of competent and honest expertise in Indian universities and medical institutions which can and should carry out such investigations. There is no need for us to ask multinational bodies for help in carrying out tasks which ought to be the prerogative and the duty of local institutions.

Hydro has been mentioned in the article as a 'benign' source. Now hydro, especially in its micro and run of the river forms is indeed one of the most safe and inoffensive way of producing electricity. Unfortunately, in India our engineers think of hydro only in terms of giant dams, which by no stretch of imagination can be considered benign.

Surendra Gadekar

Haunted Houses:
Living Within Wails of Radiation

For most people, radiation remains an abstraction, difficult to comprehend, talked about in technical terms and restricted to nuclear power plants and other military and industrial nuclear facilities.

For the people of Taiwan that reality is changing fast. Beginning since July 1992, there have been a series of discoveries of radioactively contaminated housing structures in Taipei that is making the Taiwanese question as never before the security of their own homes. To date ten buildings constructed between 1982 and 1985 have been discovered to have been built with irradiated reinforcing bar. — ("rebar"-the steel rods used to support concrete). These structures have become known to the Taiwanese people as haunted houses; with their invisible killer lurking inside.

In late November, the threat spread for the first time outside of Taipei, to the city of Taichung, where anti-nuclear coalition for Taiwan members investigating for irradiated rebar discovered extremely high radiation levels not inside a structure, but in its iron front gate and door. This new discovery has two major implications. That the possibility of radiation in buildings must now extend beyond Taipei to the whole island, and that it no longer can be confined to rebar; all types of iron and steel products regardless of their manufactured date may be contaminated.

On July 30 of last year the atomic energy council (AEC) received an anonymous letter from **a** resident of the Taiwan power company workers dormitory in Taipei, stating that the dormitory was showing high radiation levels and demanding an investigation. On investigation the AEC found, 14 apartments to have radiation levels up to 76 millirems per hour. That level is 6500 times the safety standard of 100 millirems per year for public exposure set by the International Council of Radiation Protection (ICRP). When compared to Japan, Taiwan's nuclear neighbour, we find it 130000 times the Japanese suggested standard.

Two weeks later, on August 15, news broke that the Min Sheng Villa apartment in Taipei also had high radiation levels. Investigation showed that of the 70 apartments, 34 had radiation levels similar to those in the Taipower dormitory.

More cases followed. On September 5, the Energy Commission building at the Ministry of Economic Affairs was also discovered to be contaminated (Not a few people claimed this ironic justice). Four days later, another 7-story building in Taipei was found contaminated. This time the AEC refused to reveal the name of the building.

It soon became obvious that the Atomic Energy Council was not prepared or not willing to deal with this crisis. It was not until October 7 that the AEC formed an Irradiated Rebar Steering Committee. One of their first proposals to deal with situation was to buy cancer insurance for residents of the Min Sheng Villa. (One wonders when buying insurance became part of the Atomic Energy's Council's responsibility?) In mid-October the AEC finally began distributing radiation testing units to residents of potentially contaminated buildings.

Frustrated by AEC's slow maneuvering, residents of the Min Sheng Villa formed their own

Where Did it come From?

The origin of this radiation remains unclear. The problem seems to originate in a batch of iron that was produced around 1982. To date, the contaminated steel that has been identified-some still has not been traced-has all come from Jin Shan Steel Company. However, the source of the original iron is still unknown. There is speculation that the iron was imported, but this remains unproven.

What is certain, is that in the process between Jin Shan's purchase of the iron and its use as rebar and other steel products, it was not checked for radiation. Whether this was due to deliberate cover-up, negligence on the part of AEC, or sim-

"Self-Rescue Committee' to represent them in dealing with the government. They finally forced the AEC to agree to provide medical examinations for the residents of the villa. However, the long term problem—what to do about the building itself—is still not solved. No agency is willing to put forth the money to reconstruct the building.

The AEC Complicity

The most frightening aspect of the case is the fact that the AEC was aware of the high radiation levels in the Min Sheng Villa as early as 1986, but chose to disregard the problem. At the time, a dental clinic operating in the Min Sheng Villa reported extremely high levels of radiation even when their machines were turned off. After investigating, the AEC suggested that the dental clinic lead-plate the walls, and then closed the case.

The Spreading Fear

The response of the people to the news has been to demand radiation testing in their own homes and offices. As more such cases are discovered, this fear is bound to grow. Geiger Counters may become the hottest selling product on the island. The Taiwanese public is for the first time, becoming aware of the need for strict regulation and better enforcement of nuclear safety standards.

Taiwan's "haunted houses" represent something far deeper than the ten individual cases found so far. They are a symbol of a dangerous source of energy mishandled in a small island country where nuclear accidents can cause disaster to millions of people. For the people of Taiwan, the only solace lies in the knowledge that the incidents have helped in creating public awareness regarding the dangers of nuclear power.

Nuclear Report from Taiwan

Nuclear Lobby Returns to Power in Russia

Fire broke out at the Chernobyl nuclear power station, but officials said that there had been no increase in radiation. Ukrainian news agency quoted an official at the station, as saying that the fire broke out in a room housing technical equipment between the station's first and second reactors. This has nothing to do with the nuclear process," Viktor Borisenko, technical shift foreman told the agency. There was no change in radiation levels. There was no violation of safety norms. No one was injured."

The Russian government has approved a massive programme of nuclear power plant construction ending a moratorium inspired by the 1986 Chernobyl disaster which sent radioactivity spewing across Europe, according to documents ' and interviews.

The ambitious building plan which would add at least 30 new nuclear power stations and double the nation's nuclear energy capacity by 2010 AD is likely to heighten alarm in Europe already concerned about safety standards in the former Soviet Union's atomic industry.

The plan was approved without publicity at a December 24, 1992 cabinet meeting despite objections from President Boris Yeltsin's ecology advisor Alexei Yablokov who called it "unacceptable from the legal, ecological, economic and political points of view."

The programme is designed to guarantee energy supplies as Russia's oil industry falters and its economy becomes ever more dependent on revenues from oil and gas exports. Critics here said it also reflects the resurgence of the atomic industry powerful and well-funded in Soviet days and the weakness of Russia's fledgling environmental movement.

At least one of the new plants would be of a design similar to the Chernobyl plant that exploded in 1986 bringing death

Next Door in Finland

The Finnish Parliament passed by 96 votes to 78 an amendment to the bill setting out government's energy policy. The amendment stated that nuclear power should not be part of Finland's energy strategy. The government had hoped for a favourable legislative decision, after which it would have submitted for approval or rejection by parliament a decision in principle to build a new, fifth unit in Finland. In the event, the Prime Minister, Esko Aho, is reported to have told his party that the decision in principle to build a fifth unit could not now be submitted to parliament.

However, despite the clear mandate from the representatives of the people in a democracy, the country's main electricity suppliers intend to keep alive the nuclear option for baseload generation.

and illness to thousands of
Ukrainians and Belarussians.

Yevgeny Reshetnikov, deputy minister for atomic energy, said the design had been improved to prevent a similar accident but western experts here maintained that the inherent dangers if a Chernobyl-type plant cannot be eliminated.

Russia's ability to implement the building programme may be limited by the disastrous state of its finances. But approval of the new programme signed into law on December 28 as one of Prime Minister Viktor Chernomyrdin's first official acts reflects Yeltsin's commitment to overcome seven years of popular opposition to nuclear power.

Environmental groups here and in the West argue that political instability, antiquated systems and economic hardship make another nuclear catastrophe uncomfortably probable.

Reshetnikov rejected criticism of his industry in an interview saying Russian power stations are as safe as those in the West and calling Yablokov a 'dilettante.' To continue a moratorium on construction, Reshetnikov said, would bring 'catastrophe' to certain regions that are especially dependent on nuclear power.

The deputy minister, a veteran of the Soviet atomic industry shrugged off the possibility that Russia's decision to spend billions on atomic energy might discourage Western countries from delivering promised aid to improve the safety of existing plants. Reshetnikov complained that in any case Europe and the United States have given little beyond promises, documents and site visits.

The approved programme calls for spending 100 billion roubles this year and every year through 1996.

The Independent

Lessons from Chernobyl

Hydro-Ecological Nuclear Power Plant Site Selection

The Chernobyl accident makes it necessary to review the way nuclear power plant sites are chosen from a hydro-ecological point of view. It is also essential to study existing emergency response and remedial measures for their adequacy, said a workshop on the hydrological impacts of nuclear power plants, held under UNESCO auspices at Paris between 23-25 September, 1992.

The fifty participants, hydrologists from Commonwealth of Independent States and other countries, called for the creation of an international co-operative research pro-gramme to study the planning, risk assessment and remedial actions in case of accidents.

Their statement pointed out that accidents at nuclear power plants, which release major quantities of radionuclides into the water cycle, can endanger the safe exploitation of water resources over large areas, far beyond national borders.

"Although it is less important than contamination through the atmosphere or through food, water contamination lasts the longest, much longer that any other form. It can last for hundreds or thousands of years in the groundwater", said Abraham Mercado, Consultant of Hydrology and Environmental quality, and one of the key speakers at the workshop.

Reports presented at the workshop made it clear that although the water contamination affecting the inhabitants around Chernobyl has been of secondary importance compared to other forms of contamination, radionuclides have moved to the shallow groundwater aquifers at a faster rate that expected. This shows that the ways radionuclides move through the unsaturated zone are not known in detail.

Under different conditions than those at Chernobyl the consequences on water might be more serious, especially if water resources are scarce or of high economic value, **the workshop** pointed out. The **worst case for** water **resources would be a** melt-through, **where the bottom** of the **reactor gives way, and** the radioactive matter is released straight down.

Groundwater, which circulates at relatively shallow depths, from tens to hundreds of metres, is very vulnerable to that kind of pollution, and can transport contamination over long distance. It is also hard to track or contain contaminated groundwater.

Three main aspects were identified by the workshop for the hydrological assessment of nuc-lear power plants: the need to protect the power plants from dangerous hydrological phenomena such as floods and mudslides, the need to have a reliable water supply for the operation of the power plant, and the assessment of a nuclear power plant's impact of water systems— through radioactive, chemical, or thermal contamination.

An ideal site for a nuclear power plant, from a water point of view, would be on solid rock, where the groundwater is very deep down, where the unsaturated zone is as impermeable as possible, and where the ground-

water flows are well known and simple.

Also, it is necessary to seek **ways to** retain contaminated **water in** case of an accident, to reduce the spread of contamination. At present there is no reliable way of doing that, nor is **there a** good method for decontaminating household water. Both these topics need further study, the workshop concluded.

Follow-up of Chernobyl

For the follow-up of the Chernobyl accident, the workshop called upon the international scientific community to support researchers working in the region by providing technical assistance and equipment.

The radioactive material released from Chernobyl continues to move about in the affected ecosystems - but we do not yet know enough about this migration to predict the effects on the waters.

The major part of the radioactive fallout on the European territory of the Commonwealth of Independent States entered the catchment area of the Pripyat, Dnieper and Desna rivers. Most of it is contaminated at a relatively low level, but as the area is very large, the cumulative amount washing out into the rivers can be higher than that in small **catchments that** received larger amounts of fallout.

After the accident, measures were taken to limit the spread of radionuclides into the waterways; in total 131 various constructions were put up by May 1987. River barrages were built with absorbent materials, which were intended to absorb caesium **and** shortlived radionuclides, and stop them from spreading further.

These barrages quickly silted up, causing the water level to rise and flood large areas with a high content of radioactive material in the soil. As a result, even more radioactive material washed out into the rivers.

"In addition, it turned out that absorbent material **in** the dams only soaked up a small quantity of nuclides, **and** most of them were dismantled after the spring of 1987", reported Oleg Voyrsekhovitch, of the Ukrainian Hydrometeorological Institute.

Four traps were constructed in the Pripyat river, to catch suspended radioactive particles **from the** stream of water, which **were** supposed to be deposited in the bottom.

"Unfortunately, the traps were not fine enough to catch the mobile particles, and at best only caught about ten percent of them", Voytsekhoviteh said in his presentation. In the end, natural river pools and stagnation zones accumulated far larger quantities of radioactive material than the traps.

The work of limiting the damage was hampered by the lack of sufficiently accurate methods of modeling and forecasting the state of water systems. The ways radionuclides move between soil, water, sediments, surface water and ground water are not known well enough, suited a report by the Russian National Committee for the International Hydrologieal Programme.

The workshop was arranged by UNESCO's International Hydrological Programme, the Commission of European Communities, the International Atomic Energy Agency and the United Nations Environment Programme

Nucleo Rats Quit the Fast Sinking Breeder

This news item appeared in the November/December issue of Atom which was the official journal of the U.K. Atomic Energy Agency and is now, in the era of privatization, brought out by AEA Technologies which is a major supplier of nuclear industry technologies. (Of course, the heading in the Atom was different.) The news is of special interest to us in India, since the Indian nuclear dreams are. all based on the 'success' of the breeder. The fact, that the breeder has proved to be a technological mirage in other parts of the world has yet to dissuade our blinkered nucleomules.

The British government has decided to cease at the end of this financial year its £12.87 million annual funding for R&D in support of the European Fast Reactor (EFR), a multinational development programme to commercialise fast reactor technology, effectively putting an end to fast reactor R&D in the UK.

Earlier this year the government confirmed it would not **support operation** of Prototype **Fast** Reactor (PFR) at Dounreay beyond March 1994. (PER is

now scheduled for restart early next year after a shutdown for repairs). The only fast reactor funding it is now prepared to countenance is a small programme of experiments related to the closure of PFR.

The UK nuclear industry was not prepared to accede to a government request that it become solely responsible for funding fast reactor R&D. According to Nuclear Electric: The request was made more difficult because it came a year earlier than expected, long before the EPR Phase II development work—on which the promised 1993 review of fast reactors was to be based—had been completed."

Britain's nuclear utilities, Nuclear Electric and Scottish Nuclear, which have always seen the EFR programme as a joint effort between government and industry, will not continue to fund design work once the government ceases to fund the supporting R&D.

EFR on hold?

With commercialisation of the fast reactor not anticipated before about 2030, neither France nor Germany are particularly anxious to press ahead with EFR at this time; although equally, neither wishes to abandon fast reactor development. In France, experience with the 1200 MW Superphoenix fast reactor has been a salutary indication of the problems that can be encountered; while the relicensing process for the reactor following criticisms by the French safety body IPSN (See *Amumukti* vol6 Nol) which has only just begun, is expected to last many months.

In Germany, where a 300 MW prototype fast reactor was built but never allowed to operate, government spending is increasingly focussed on the economic problems in the east of the country.

It is therefore considered unlikely that France or Germany would wish to carry on work towards construction of a large commercial demonstration fast reactor alone.

Atom
Nov / Dec 1992

Only Financial Ingenuity Can Now Save The Indian Nuclear Programme

The following article appeared in The Times of India on 24th of October, 1992. It presents the thinking within the nuclear establishment in times when the usual government largess has become somewhat scanty due to financial strain and there are some muted calls for 'accountability'.

hanged geopolitical equations have ruined India's chances of expending the nuclear power programme with Russian help. But the country is by no means in a hopeless position. With financial resourcefulness more than technological savvy, it can retrieve the situation.

In the footsteps of France, which recently baulked at supplying enriched uranium for the Tarapur atomic power station to a non-NPT regime, Russia is having second thoughts about its turnkey project to supply a pair of 1,000 MW reactors at Kudankulam in Tamilnadu.

The inter-governmental agreement for the Kudankulam project was signed with the erstwhile Soviet Union during President Gorbachev's visit to New Delhi in 1988. It provided for a steady supply of enriched uranium and the return of spent fuel.

What sweetened the deal for India was the soft loan of 3.2 billion roubles—worth Rs 5,000 crores then—at a 2.5 percent interest. This was to be repaid in 14 equal installments, starting three years after commissioning the plant in 1998. The foreign exchange outflow - imports of some components worth a few million dollars - was minimal since the plant was to be re-designed for tougher safety standards and was to be made with Indian manpower and facilities, payable in Rupees.

The sweetener has turned sour in the economic crisis following the break-up of the Soviet Union. The Russians reportedly want to renegotiate the agreement to supply most components rather than a turn-key project. More important, they would like dollar repayments with higher rates of interest.

What are India's **options under the** circumstances? An **inside** source, insisting **on anonymity** states, **like Barkis, Boris may be willing, but can he fulfil the partnership? Even**

if India accedes to the Russian demands, our problems will not necessarily end.

With central authority gone, except for a large corporation like Atommach, the performance of their smaller companies, scattered across the former Soviet Union, is a big question mark.

Editor's Note: In the meanwhile President Yeltsin has come and gone and there was no mention of Koodankulam in the newspapers. Therefore, it would not be wrong to assume that both sides have given-up the project and diplomatically kept silent about it.

The alternative is to build indigenously designed pressurised heavy water reactors. The design for 500 MW units is ready for implementation. The site can also take a quartet of proven 220 MW units. The main advantage of these reactors is that the fuel, natural uranium, moderated and cooled by heavy water, would be readily available within the country.

The strategic and economic importance of such self-reliance cannot be over-emphasised, says one expert. Nor does large-scale import of atomic fuel make financial sense for a country with a balance of payments problem, he adds, particularly when it has domestic reserves of 700 billion tonnes of coal equivalent of thorium and recycled uranium. By contrast, India's coal, gas and oil reserves together add up to 152 billion tonnes of coal equivalent.

The caveat is that the extraction of all that atomic energy depends upon the how successfully the country can meet the challenge of developing the entire three stage nuclear technology, the do it yourself option. Even at the first stage of extraction of energy from natural uranium, this option places a massive financial burden on India. The investment at Kudankulam envisaged Rs 2,500 crore for two units of 220 MW or Rs 5,000 crore for two 500 MW units with a gestation period of six to seven years. At 1991-92 prices, without escalation or interest during construction, this works out to Rs 30,000 per kilowatt.

Editor's Note: It is statements like those above which reveal that the nuclear establishment in the country still does not want to give up its old habitual devious ways. Half-truths are mixed with fantasies and outright lies. Words like "strategic importance" and "self-reliance" are a much repeated mantra the moment the deal becomes sour, how come we forget them when offered a little "sweetener" in the form of a low interest easy repayment loan. Is the strategic and economic importance of self-reliance pertinent only now and was not so important while the deal was being struck? In fact, the previous chairman of the Department of Atomic Energy, Dr P.K.lyengar is on record having said in March 1992 that India wants help from the World Bank and other international financial institutions for the development of the nuclear programme.

Of course, it is only in the nucleocrats' arithmetic that Rs 5,000 crores for 1,000 megawatts works out to Rs 30,000 per kilowatt. Ordinarily it comes to Rs 50,000 per kilowatt

Originally, Kudankulam accounted for Rs 6,494 crore, out of the total planned outlay *of* Rs 14,400 crore proposed for the eighth plan. The goal was to set up a nuclear power capacity of 7,700 MW by the year 2002 AD. Even after leaving Kudankulam out, the Planning Commission, has agreed for an amount of Rs 4,119 crore. Even this sum has to be split between open market borrowings, internal resource generation,by the Nuclear Power Corporation and government equity which is barely Rs 619 crore.

At the time of setting up of the Nuclear Power Corporation, the governments commitment was for a debt to equity ratio of 1:1. The government has not been able to stick to this figure. The ratio is now as high as 4:1. This means that the Nuclear Power Corporation has to borrow four rupees from the market by floating bonds for getting one rupee from the government as equity.

Public sector unit bonds have few takers today, however, thanks to developments like the banking shares scam. And borrowings from the open market at anything between 17 to 20 percent interest is counter-productive for atomic power projects which have long gestation periods. The inhibiting factor is the high interest during construction which can jack up the total cost of the project by more than half.

Editor's Note: It is interesting to note that despite these counter-productively high interest rates and some of the longest gestation periods in the world, Indian nuclear reactors, still turn out to be, according to Dr. P.K.Iyengar, the cheapest reactors in the world. Financial ingenuity in the form of creative book-keeping has always been the hallmark of the Indian nuclear programme.

Nor is the NPC like other public sector units. Given the nature of its operations, involving strategic materia] and high tech inputs which only government has been able to sustain so far, the privatisation of atomic energy has certain in-built limitations.

One way out is to seek creative resource management like preferential equity participation (without voting rights) and the other is to involve energy strapped state governments or even private companies in a sort

of assured power supply programme in exchange for equity.

Would all these problems be resolved by signing the Nuclear Non-proliferation Treaty and accepting full-scope safeguards? Not really. The days of soft loans, especially for nuclear power, are gone, says one expert. With safeguards we could perhaps be free to go to France rather than Russia for the Kundankulam project. But we would still have to pay for the technology in addition to being dependent for enriched fuel on them.

The best option then is to build reactors using India's own natural uranium. The only countries besides Canada which have the expertise are Korea, Argentina and India,

That brings the country back to square one. Even after signing the patently discriminatory NPT — which puts the facilities of the weapons-have countries of pre-1969 vintage beyond the pale of inspection — India will still have to find the finance to pay its own home-grown technology. That is not such an insuperable task for a nation that has mastered the far more arduous technological path.

Vithal C Nadkarni
The Times of India October 24, 1992

The Militaries' War On The Environment

That humans make war on the environment is a widely used metaphor, which becomes literally true when nations make war on each other. From Vietnam to Central America and Afghanistan to the Persian Gulf, warfare has had grave ecological consequences that affect not only the environment, but the health and security of the people who depend on it. And the negative impact of the world's armies on the environment neither begins nor ends with a shooting war. Every day militaries use up non-renewable resources, pollute water sources, and contribute to ozone depletion.

Images from the Gulf War of the smoke-darkened Kuwaiti desert with oil wells burning out of control was a stark reminder of the environmental damage of war. Ongoing revelations of radioactive pollution from nuclear weapons sites in the United States and the former Soviet Union point to the costs of peacetime military activity. More recently communities are becoming aware of the environmental impacts of military bases and the numerous toxic chemicals they use. All of these revelations have helped lift the veil from the myriad of ways that militaries wage war on the environment (and all of us), even when they are not waging war on each other.

The Gulf war is vivid case study in the damage that war can cause the environment. While the hundreds of oil fires have been extinguished, oil lakes still cover the Kuwaiti desert. Oil still contaminates the Gulf and little has been done to clean the hundreds of miles of coastline. Studies to determine the full extent of the damage to important and fragile ecosystems critical to a range of animal and plant species have only begun. Heavy military vehicles and military fortifications have dug up and packed down the deserts of the region that, lacking water, will take years to recover. A year and half after the end of the war little is known about the full extent of environmental damage caused by the bombing of Iraq's nuclear and chemical weapons facilities and petrochemical and other industrial sites. The bombing of Iraq's electrical system caused widespread disruption of sewage and other critical systems polluting water supplies and spreading disease. Throughout the developing world, immigrant workers in the Persian Gulf fled home as Gulf War refugees increasing stress on rural ecosystems and urban areas.

Resource Use

Like the Gulf War, many wars are about access to resources. Michael Renner of Worldwatch Institute estimates that the world's armies use as much energy as the economy of Japan, about six percent of total use worldwide. An F-16 fighter burns more fuel in an hour than the average U.S.car does in one year. Militaries account for nine percent of the iron and steel consumed each year. They also use a large proportion of such minerals as beryllium, cobalt, and titanium. In a self-perpetuating cycle, nations create armies to gain access to resources that their armies must consume in order to function.

Militaries have a seemingly insatiable appetite for land to train on. This need has risen steadily as armies have grown larger and weapons have become more technologically advanced. Modern artillery can shoot farther. Up to one percent of land worldwide is directly used by militaries. Every year additional land is damaged or made unsuitable for civilian use. Unbearably loud noises from overflights by jets can cause health and other problems for residents and wildlife below

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training areas. In recent years protests against low-flying jets in Europe and across the United States are beginning to curb the impunity with which western air forces disturb those below.

Large tracts of land are also destroyed during war. Operation Ranch Hand sprayed 18 million gallons of herbicides on more than six million acres in Vietnam and a lesser area in Laos and Cambodia. That land is only beginning to recover. Track marks can still be seen in the deserts of North Africa, reminders of the massive tank battles of World War II.

One of the longest lived legacies from many wars is the thousands of rounds of unexploded bombs and mines left over from many wars. These bombs can maim and kill and unless thoroughly cleared they make use of the land dangerous for decades. German mustard gas shells, lobbed during World War I, are still occasionally uncovered. Unexploded ordnance is still a major problem in Vietnam, sending numerous children and farmers to the hospital 17 years after the war. Mine clearing is a big and dangerous business now, with companies vying for contracts to remove mines in Angola, Kuwait, and Cambodia.

Toxic Chemicals and Hazardous Waste

While negotiations on a treaty to ban the possession of chemical weapons recently ended, militaries wage chemical warfare daily on their own citizens by using some of the most lethal chemicals known—not to wage war but to prepare for it. Solvents, PCBs, pesticides, heavy metals, alkalies, propellants and explosives then need to be disposed of safely. According to Pentagon's Defense Environmental Restoration Programme, 17,482 toxic hot spots have been found at the 1,855 domestic installations. (The U.S. does not provide figures for its overseas military bases.) A toxic hot spot is a place where hazardous waste contamination poses a potential threat. Areas around many conventional and nuclear production facilities are also contaminated. The costs of cleaning up these sites are astronomical and estimates vary widely, anywhere from $50 billion to $200 billion.

As a number of militaries begin post-Cold War reductions,

Missile Testing range coming up in Hunsur taluk

The defence ministry has decided to establish a "missile- testing range" in Kuppekollagatta area of Hunsur taluk about 82 km from Mysore and construction work at the site is in full swing under the supervision of the army engineers.

The army has acquired about 5,800 acres of land belonging to the revenue and forest departments and initiated measures for aquisition of 925 acres of agricultural land belonging to farmers of Hosaramanahalli village in Hunsur taluk. Even the state government has appointed a special land acquisition officer for the task.

The Kuppekollagatta area — a hilly terrain selected for the purpose, is situated on the left side of the Mysore-Mangalore state highway. The authorities have kept the news of the missile testing range a closely guarded secret. Informstion gathered from various sources indicates that the construction work will take about 2 years. Even before the completion of the land acquisition process, the military authourites have started construction of compound wall of the range and a Hyderabad-based construction company has been given the contract.

The range was earler proposed in Bijapur district, but strong opposition from the public forced the defence ministry to shift the range from there to Mysore district. This was one of the reasons why the authorities have kept the establishment of the range such a secret ," according to an official. Even the Assitstant Commissioner of Hunsur, M.Kumara Naik said that he was unaware of what exactly was proposed. There is a proposal for the establishment of some kind of a defense project but 1 don't know the details," he said,

The news of the establishment of the range seems to have bewildered villagers of the surrounding villages. Particularly worried are the residents of Hosaramanahalli, who arc losing all their land for this development project. As the name of the village suggests, they had originally belonged to Ramanahalli village which was submerged in the waters of the Krishnaraj Sagnr Dam. Mr Linga Naik, an eighty year old farmer, related the story of how it had required years of efforts before the government had allotted land in compensation for the land they had lost in submergence.

Meanwhile, activists of the Karnataka Vimochana Ranga who have come to know of the project, were trying to educate the people about the I-effects of the project and mobilise the people against it. Mr Puttaswamy, an activist said the unicn government was converting Mysore into an 3rsenal. "First came the uranium enrichment plant at Rathnahalli, now the missile testing rane and what is more in store for Mysoreans is not known,' he exclaimed

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the need to isolate and clean up chemical pollutants will delay alternative uses at many military bases. Also delayed will be the economic recovery of communities around the bases open or conduct shoddy clean ups.

Contamination of U.S. nuclear weapons facilities alone may cost $200-$300 billion to clean up

There is every reason to believe that contamination at the bases of other militaries is as bad or worse. Germany recently put former Soviet soldiers awaiting repatriation to Russia to work locating dumps created in East Germany. No oversight from host governments and poor record-keeping or a lack of any records mean that an unknown number of toxic time bombs are seatte red throughout eastern Europe.

The disposal of chemical weapons poses a number of special environmental hazards. After World War II, stocks of chemical weapons were haphazardly dumped in several ocean areas. Now the U.S. and Russia have adopted incineration as the preferred disposal method, ignoring and inadequately researching safer alternatives. The U.S. moved chemical weapons from Okinawa and Germany to Johnston Island in the Pacific in 1972 and 1990. Pacific Islanders now fear that the U.S. will incinerate its entire stockpile of chemical weapons at Johnston, ignoring their wishes and well-being.

Nuclear Contamination

Toxic and nuclear contamination from nuclear weapons production and testing have created life-threatening conditions in many parts of the world. Nuclear tests have spread deadly radioactive isotopes world-wide. Contamination from test sites, military nuclear reactors, warhead assembly plants, and haphazardly created waste sites is migrating into water supplies and the air, threatening the communities and ecosystems around them. Safe ways to clean up and dispose of millions of tons of radioactive waste produced by uranium mining, weapons production, and now, the dismantling of nuclear warheads remain elusive. Contamination of U.S. nuclear weapons facilities alone may cost $200-$300 billion to clean up over the next 30 years. Nuclear hot spots in the South Pacific, U.S., former USSR, China and elsewhere will threaten the health of many for years to come.

Indigenous people have especially suffered from the nuclear arms race. Their lands and waters in North America, the Pacific, North Africa, former USSR, Australia, and elsewhere have been irradiated by nuclear tests by the major nuclear powers. It is still not safe for Marshall Islanders to remhabit their original islands. In Australia, the aborigines received little or no warning before the British tests contaminated them in the 1950s.

Above ground nuclear testing contaminated the atmosphere, but many underground nuclear test leak radiation as well. Other military activities are affecting the atmosphere as well. The military is responsible for over two-thirds of U.S. use of the ozone depleting chemical CFC-113. While the Pentagon is moving away from CFC use, the high cost of changing military specifications is stalling the conversion to safer chemicals in the U.S. and abroad. Because many other nations follow the U.S. lead when it comes to technical requirements in weapons production. Exhausts from solid fueled rockets and missiles inject large amounts of ozone harming hydrochloric acid directly into the upper atmosphere.

National Security

Militaries citing "National Security have hidden their environmental crimes behind a veil of secrecy. In many nations, the military is often exempt from environmental rules and regulations either by law or by custom. In recent years, Congress and grassroots protest have increasingly brought military activities under environmental laws and regulations that apply to others, but the Pentagon and the Department of Energy continue to resist efforts to treat them like any other polluter. And most environmental laws contain loopholes that allow the President to cite a national emergency to exempt the military.

The military is responsible for over two-thirds of U.S. use of the ozone depleting chemical CFC-113.

The military harm to the environment is not confined to its direct impacts. Hundreds of billions of dollars worldwide are spent preparing for war. Military spending continues to consume monetary, human and other resources short-changing environmental protection, development and other social needs. Billions more must now be spent on cleaning up military messes.

Many politically involved militaries protect, promote, and often directly benefit from environmentally destructive projects and activities. They are used to suppress opposition to harmful projects , stifling any environmental debate. The wholesale destruction of the Amazon began under the military dictatorship in Brazil. Burma's military is cutting down its teak forests, trading the wood for arms and cash to support its dictatorship. In the name of anti-communism, the Philippine army suppressed dissent against environmentally, de-

structive forestry, hydroelectric and other projects during and after the Marcos regime.

New Image

Many of the world's militaries, seeing which way the public opinion winds are blowing, are working to improve their environmental practice and image. In the United States, the Pentagon regularly proclaims this or that environmental innovation. Several years ago, the Senate passed the Strategic Environmental Initiative: the proposal to fund the military to release environmental data and do environmentally useful work. But the military mindset on this matter was revealed when, after a long delay, the Pentagon proposed the first project under SEI find a more environmentally benign way to produce plutonium triggers for nuclear weapons.

At Pentagon conferences during the build up toward the Gulf War, Secretary of Defense Richard Cheney put best face on military environmental pract ice, admitting the need to remedy past mistakes and championing efforts to recycle, substitute non-toxic materials for harmful ones, and preserve nature on military bases. But Admiral David Jeremiah, vice chair of e Joint Chiefs of Staff, made clear that there are limits to how gently armies can adapt to the environment. When forced to choose, the military's mission comes before environmental protection. War and preparation for war are "always inherently destructive and inefficient," ho said.

A major international opportunity to deal with impacts of the military on the environment was lost last spring when the UN Conference on the Environment and Development (UNCED) sidestepped these problems. The US delegation worked hard to keep military matters off the agenda and proposals holding nations accountable for how their militaries handle their hazardous waste and contaminate the environment with their weapons of mass destruction were watered down or deleted

Many things can be l done to alleviate some of the most environmentally harmful practices of militaries measures that must be taken as steps toward disarmament regardless of whether bases remain open or are closed. But in the end militaries will have to be eliminated to finally bring an end to their war on nature and on us.

John Miller
Nonviolent Activist Nov./Dec. 1992

Wall Street Blues

In March, 1992, Lehman Brothers, the Wall Street investment house, held a half-day conference titled "Are Older Nuclear Plants Still Economic?" Last week an Oregon utility announced plans to shut a plant that is just 16 years old, the third such retirement announcement in U.S. this year. Paul C. Parshkey, the organizer of the March conference, said that perhaps he had misnamed his event. The question is not whether the older reactors are economically sensible to operate, he said, but whether any are?

When is a reactor old? If Trojan, the Rainier, Orepm, plant, is indeed closed in 1996, it would be only halfway through its anticipated 40-years life span. Reactors seem to age on some accelerated calender. Trojan's steam generator is deteriorating. Steam generators, which transfer heat energy out of the reactor, are common to one type of plant, but each design has a characteristic weak spot that grows worse with age?.

The nuclear industry was well on its way to extinction, even before the announcement by Portland General Electric, which owns and operates Trojan Nuclear Power Plant. There are few replacements in sight for Trojan and 109 other commercial operating plants in the U.S.

"The question Is not whether the older reactors are economically sensible to operate, but whether anv are?"

Throwing in the towel on a plant like Trojan is a painful decision. In the era of "not in my backyard", it means giving up operating permits that will be hard to replace And running it longer would give more time to accumulate money for tearing it down and disposing of nuclear wastes; so far there is $25 million in the company's piggy bank against a cost it has estimated to be at anywhere from $200 million to nearly $500 million.

But the world has turned nasty for Trojan, in ways the builders never expected. When Trojan entered service, Congress made it illegal to build new gas- fired power plants, because the accepted theory was that North America was running out of gas. Now Canadian gas supplies glut the West Cost,

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making gas a cheaper power source than a wheezing reactor.

And in the early years of Trojan's life, demand for power was galloping ahead by as much as 7 per cent a year. But today, a refrigerator bought at an appliance store uses half the electricity of an average model bought when Trojan was new.

Those factors affect many plants, but not all are threatened. "You're looking at a universe of 110 reactors", said Carl Goldstein, a spokesman for, the nuclear industry's public relations arm. "It doesn't seem startling to me that you have some defection". Trojan, he said, faced politically stiffer opposition than most plants. It survived statewide referendums in 1986 and 1990; another is due this November. It was in a region with so much hydroelectricity that it was not needed year-round, a disadvantage for a capital-intensive technology.

Political Challenges

Some detrimental factors can change, said Mr. Goldstein. The price of gas will rise someday, and the Clean Air Act will make coal, which is the main source of electricity, more expensive.

And some reactors may be able to run much longer. Those that are well-maintained could continue for a long time, said Mr. Parshley, the Lehman Brothers executive who organized the March conference. But their overall durability will only be proven plant by plant. Last year the Nuclear Regulatory Commission approved a procedure for utilities to apply for 20-years extensions to their plants 40-year licenses. The plant that was widely expected to apply first, however, Yankee Rowe in Rowe, Massachusetts quit at age 32 earlier this year.

Not every piece of machinery wears out early. "You have children of B-52 pilots fiying B-52's now", Mr.Parshley said.

Utilities and regulations are scrutinizing the alternatives to reactors more closely. A company might choose to spend $50 million on subsidies to customers who replace their old, inefficient refrigerators and air conditioners, because that will do more to solve the power problem than spending the money on building, fueling and staffing a new plant. Or the company might find it cheaper to buy power from independent generators. Two days after its Trojan an-

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nouncement, Portland General Electric said that it would put money in windmills.

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The Rehabilitation Grinder

Once upon a time, the Satpura mountains and the Tapti valley which originates from these mountains were both covered with thick forests. Nowadays, one is lucky to see maybe a tree or two out here to remind one of the glory gone by. Of course, there are clumps of Eucalyptus trees from various "social forestry" schemes. Villages dot the farms in the river valley looking like raisins in a cake.

The Gandhi Mela, which is observed every year jointly in the three districts of south Gujarat was held this year at a small village called Khorda in Nizhar Taluka of Surat district We had gone there on cycles with communal harmony as our theme. While returning, friends invited us to take a round about route and visit their homes. "It would get you in this area which is downwind from the Kakrapar Nuclear power plant The road goes through some beautiful countryside. And you can tee some of the only bits of jungles left in Gujarat." After such an invitation it was impossible for us to refuse.

Twenty years ago, a dam was built across Tapti at Ukai. The displaced people were "rehabilitated" on both banks of the river. In the old days before independence, this area belonged to the kingdom of Rajpipla. The raja had invited farmers to come and "settle the land." A number of rich absentee landlords from the coastal region of south Gujarat had accepted this invitation, levelled the land and got it 'farmed' by "halpatia"—poor farmers. After about half a century of this farming, the land is no longer very productive. Thus, these landlords are today happy to sell the land to the government for rehabilitation. It gives them adequate money as well as prestige. They are 'helping' to build the lifeline' of Gujarat

While the immediate neighbourhood is today totally devoid of forests, there are old growth forests still extant some 15 to 20 km distant They give a fleeting idea of what the area must have looked like in the old days. Today the whole area is a giant refugee colony. Here are the old resettlements of Ukai. There the Karjan dam resettlements. And all this area is reserved for the new colonies of the Narmads displaced. All the different 'project affected persons' have received different amounts of 'compensation'. This has resulted in some jealousy. The Karjan people are envious of the Ukai lot, while the Ukai people are jealous of the Sardar Sarovar refugees.

Ummarda village is a twenty year old settlement of refugees from Ukai. An Ashram school and a post-basic school are being run in this village by the Ukai Navanirman Samtti. Some time back, a number of 'Ambar Charkhas' were running in the village as part of rehabilitation and employment generation activity; right now this activity is almost dead. At least one person from each house has to go to Surat or Ankaleshwar in search of employment as a daily wage earner. People feel cheated and there is widespread dissatisfaction at the amount of compensation. They also strongly regret the loss of their culture and the sense of community that they had in the jungles.

There are some six or seven settlements of the Narmada refugees around Ummarda. Some are as old as three years while some had people who had just arrived a fortnight back. More are coming.

Nani Bedwan is an old village. This was settled during the time of the raja. There are some non-adivasi trader families settled here from as far away as Rajasthan, M.P. and Maharashtra. Two years ago during communal tension in this area, adivasis from outside the village came and burnt some shops and beat up some people. Twenty Muslim families fled the village during that time.

Just outside Nani Bedwan is one 'new' settlement of Narmada displaced. There are three tin sheds and a hand-pump which was not working. Some 15 to 20 families have come here very recently. There isn't a green tree nearby. There are some empty cotton fields. During daytime even in the month of February, it is terribly warm inside the sheds. Everybody is sweating. Some women bring a few pitchers of water. They point to a village a kilometer away when asked about the source of the water. Outside the tin sheds are some old bamboo, some wood and roofing material still lying around. Children are playing in the midst of all this. There is very little space left after two cots are put in the shed.

"Who likes to give up their father's land and come and resettle so far away from home? First, we were fighting for land and jungles. Medha Patkar Bai is from Maharashtra. That is why the Maharashtra people say "*Koi nahi hatega, bandh nahi banega"* But we are Gujaratis. That is why we are with Ambrish Bhai and Tripti Behn. They are Gujaratis and very decent people. After all we have to go with someone amongst the sahebs. Today, every one of us has got five acres of land each. Although children of 18 years of age have still not got their five acres. An enquiry is being conducted to find out the ages of the children. Nobody has got the money for making the house. Those who came earlier, they received money for constructing houses. Each family had got fifteen hundred rupees. But we haven't got any. Our neighbours are thieves. Just last night they had come to steal our wood. It was lucky that we got up and made a noise and they ran away. We used to live in the jungles. Our village was Surpana near the river. There we had water and wood and food and medicines all from the jungles.

"Who likes to give up their father's land and come and resettle so far away from home? We used to live in the jungles. There we had water and wood and food and medicines, all from the jungles. Here, you see for yourself. There is not a tree in sight. Where will we get the firewood for cooking our food?"

Here, you see for yourself. There is not a tree in sight Where will we get.the firewood for cooking our food?"

"There we were working as farmers. When there was no work in the fields, we would work as labourers breaking stones. Here there is no work. There all of us used to work and we would earn enough to last out till the rains. We have come here out of helplessness. It is better to come now while we are still getting land rather be forced later and not get anything. Over there we used to farm seven acres of revenue land and five acres of forest land. All those who had more land, they have lost. If we work we will eat. There also we used to eat on our labour. Here too if God is merciful, he would give us the strength to labour. The land of our forefathers, irrigation facilities, all this sister is not written for us poor. The irrigation from Narmada is for those rich farmers who live downriver. It is not for us. What we have got is better than getting our houses drowned in water and loosing whatever little we have."

The Gujarat Government keeps telling us that the Sardar Sarovar resettlement is the best that there is. And then doesn't somebody have to pay the price of development? When Ukai dam was built, this area of south Gujarat became sugarcane country. Did we not all prosper because we were able to grow such things like sugarcane and groundnuts? So what if the adivasis of Uchhal and Nizhar had to loose their lands and are now reduced to a helpless state looking for employment as sugarcane cutters? If one person dies and two others can live comfortable lives then is it not better for the weak to die? Even the World Bank will tell you that the cost-benefit analysis shows that the ratio is better than 1.5. And after all these people are only adivasis. We have made a tin shed, haven't we? Given each of them five five acres of land. Even put up a hand-pump. So what if it doesn't work. These people from the jungles, what more can they expect?

When will we ever wake up from our comfortable sleep?

Sanghomtira Gadekar

Profiting From Cancer

Vested Interests and the Cancer Epidemic

For years, the medical establishment in Europe and North America, in concert with industrial interests and academic representatives, has misled and confused the public by repeated claims that it is "winning the war against cancer." But despite the vast sums of money poured into cancer research, the incidence of cancers (standardized for age) has escalated to epidemic proportions, while the ability to treat and cure most cancers has hardly improved. Moreover, there has been a concerted effort to downplay the environmental and occupational causes of cancer; by highlighting almost exclusively the role of smoking and diet, an attempt has been made to shift the blame from industrial polluters to individual cancer victims who "have only themselves to blame".

In 1990, over one million US Americans were diagnosed as having cancer, and a half a million died of the disease. Cancer now strikes one in three people and kills one in four in the US, UK and most other western industrialised countries. This compares with an incidence of one in four in the 1950s, when the mortality rate was one in five.

Since the 1950s, age-standardised cancer incidence rates in the US have increased by 43.5 per cent overall, the rates for some common cancers rocketing. Between 1950 and 1988, lung cancer increased by 263 per cent, prostate cancer by 100 per cent, and female breast and male colon cancers by about 60 per cent Rates for some less common cancers have also risen sharply: malignant melanoma (skin cancer), multiple myeloma (bone marrow cancer), and non-Hodgkin's lymphoma (cancer of the lymph glands), have increased by well over 100 per cent, while cancer of the testes and kidneys in males have doubled. Similar increases have occurred in industrialised countries besides the U.S. The only major declines have been for stomach and cervical cancers.

From 1975-1984, overall age-standardised mortality rates increased by 5.5 per cent — from 162 per 100,000 to 171 per 1000,000. Such national averages, however, obscure significantly higher cancer mortality rates within certain groups: the death rate among those over 75 years, for example, increased by 9 per cent from 1212 per 100,000 to 1351 per 100,000.

Some 75 per cent of all cancer develop in those over the age of 55. But there are notable exception, particularly some leukaemias, brain cancers and cancers of the testes, which strike mainly the young and have been increasing at alarming rates. For instance, the increase in testicular cancer among men aged between 25 and 34 has increased 300 per cent since the Second World War. Cancer rates are particularly high among the low income groups: blacks (with an incidence approximately 10 per cent higher than whites): those living near industrial plants, mines, chemical works and nuclear installations; and workers exposed to chemical and radioactive carcinogens. The rates for certain cancers are ten times higher among some industrial workers than within the general population. In addition, rates in children of workers who handle chemical carcinogens have increased sharply: the risks of childhood leukaemia are two to five times higher if there is parental exposure to spray paints, dyes or pigments during pregnancy.

Smoking as Scapegoat

Yet, contrary to their own data, both the National Cancer Institute (NCI) and the American Cancer Socioty (ACS) have insisted - until very recently - that the incidence and mortality rates of all cancers other than those related to tobacco, are not increasing: "We are not certainly experiencing an overall epidemic of cancer, except for that attributable to cigarette smoking." Similar unfounded assertions have been made by British epidemiologists such as Richard Doll who earlier this year, contrary to documented evidence, alleged that the increase in mortality from cancer "can be accounted for in all industrialised countries by the spread of cigarette smoking." Yet, as a recent study points out:

'In the USA and UK, mortality rate for lung cancer... have actually begun to decline in men, due in large part to reductions in smoking. Moreover, despite these reductions in lung cancer, incidence and mortality for many other types of cancer increased from 1969 to 1986 in 16 industrialised countries, especially in persons over age 66. The causes of these recent increases in cancer cannot simply be explained by smoking, but appear to reflect other exposures to*

changing factors in the environment.

Static Cure Rates

Highly misleading claims have also been made by the cancer establishment with regard to improving 'cure' rates for cancers (conventionally defined in terms of the number of people who survive for five years after diagnosis). In particular, the efficacy of the latest anti-cancer treatments - from cytotoxic chemotherapy to interferons and biotechnology products, such as tumour necrosis factor, monoclonal- antibodies and interleukins - have been grossly overstated.

According to NCI's own statistics, overall five-year survival rates from cancers in all ages and races improved marginally from 49.1 per cent to 51.1 per cent from 1974 to 1987 - the rates for blacks during this period actually dropped from 38.6 to 38.4 per cent Even this minuscule improvement in overall "cure" may be little more than a statistical artifact: earlier diagnosis, for example, may extend the period between diagnosis and death, leading to the conclusion that the patient has survived longer, when the cancer may have proved fatal regardless of when it was diagnosed. The rates ignore the many patients who are judged "cured", but die from the recurrence of the same cancer after they have passed the five year period. This is particularly true for women with breast cancer.

Not surprisingly, the claims made by organisations such as the NCI and the ACS for advances in the ability to treat and cure cancer are meeting increasing scepticism. Five years ago, the US General Accounting Office stated:

"For the majority of the cancers we examined, the actual improvements (in survival) have been overestimated by the published rates... NCI does not systematically alert readers of its annual statistics reviews to potential sources of bias that affect changes in survival rates. It is difficult to find that there has been much progress...(For breast cancer), there was a slight improvement... (which) is considerably less than reported."

More recently, in 1990, a leading biometrician concluded after a comprehensive review of the literature and a questionnaire survey of over 250 cancer specialists (oncologists) and research units worldwide that the benefits of chemotherapy for treating most epithelial cancers have, with the possible exception of the rare "small-cell" lung cancer, been greatly exaggerated.

"Many oncologists take it for granted that response to therapy prolongs survival, an opinion which is based on a fallacy and which is not supported by clinical studies".

Causing Breast Cancer

To make matters worse, many of the "cures" and putative "prevention" programmes promoted by the NCI and American Cancer Society may actually be causing cancer. Over the last two decades, for example, more than $1 billion has been spent on "combating"breast cancer. According to a 1991 report by the General Office of Accounting, however, "there has been no progress in preventing the disease."

NCI programmes insist that the major cause of breast cancer is a high fat diet, ignoring the considerable evidence of the role of avoidable carcinogenic dietary contaminants. These include pesticides, such as DDT chlordane and dieldrin which concentrate in animal fats, and exogenous oestrogens in animal fat, due to the unregulated use of growth-promoting hormones as additives in animal feed.

Apart from adhering to such myopic science, the NCI and ACS have failed to investigate the carcinogenic hazards of mammography, particularly the relation between recently increasing breast cancer rates and high-dose X-ray mammograms administered to some 300,000 women during the 1970s as part of the Breast Cancer Detection and Demonstration Programme. Based on a wide range of previously published epidemiological data, a group of international radiation specialists estimated in 1972 that breast cancer risks would be increased by approximately one per cent for every rad of exposure. Thus, a premenopausal woman having one mammogram a year for 10 years, with a conservative estimated dose of two rads per exposure, would have a 20 per cent excess risk of contracting breast cancer. A confidential memo by the senior NCI doctor in charge of screening programme may explain why women were not alerted to this risk, in spite of warnings by the US National Academy of Sciences and by the NCI's own key scientific staff. The memo, which may also account for the cancer establishment's enthusiasm for the BCDDP programme stated;

"Both the ACS and NCI will gain a great deal of favourable publicity because they are bringing research findings to the public and applying them. This will assist in obtaining more research funds for basic research and clinical research."

The NCI has now embarked on a "prevention" trial which can only be described as a prospective experiment in carcinogenesis. Some 16,000 healthy women - deemed to be at increased risk of breast cancer for

familial and other reasons, including just being aged over 60 - are to be given tamoxifen, a drug which it structurally related to the synthetic growth-promoting hormone DES. Manufactured by the giant British pharmaceutical company Imperial Chemical Industries (ICI), tamoxifen not only binds very tightly to DNA, —a general characteristic of carcinogens— making it "a poor choice for the chronic preventive treatment of breast cancer" - but has also been described as "a rip- roaring liver carcinogen." This experimental evidence of potent carcinogenicity is confirmed by two case reports of liver cancer among 931 women receiving 40 milligram doses of tamoxifen for treatment of breast cancer.

Conflicts of Interest

Cancer care is big business; annual cancer drug sales in the US total approximately $1 billion. Underlying the NCI's fixation with diagnosis, treatment and research into new drugs and other "cures" is an institutionalised alliance between interlocking professional and financial interests; the highly profitable pharmaceutical industry is at its hub.

Core members of this alliance - the "cancer establishment" - include:

- The National Cancer Institute and the powerful "philanthropic" American Cancer Society.
- The major US "cancer centers" , notably New York's Memorial Sloan-Kettering cancer hospital, whose annual budget exceeds $350 million, and Boston's Dana-Parber Cancer Institute;
- University departments and staff under contract to the NCI and the ACS or receiving grants from them;

. Major pharmaceutical corn- Multiple connections between this cancer establishment and chemical, pharmaceutical and biotechnology companies have spawned "the drug-development industrial complex". Furthermore, a "revolving door" operates between the NCI, the major cancer centers and the drug companies. For example, Stephen Carter, head of drug research and development at Bristol-Myers Squibb, is a former director of NCI's Division of Cancer Treatment

A still more obvious conflict of interest relates to the three- member executive Cancer Panel which controls NCI priorities and policies. The panel is appointed by the US President under the terms of the 1971 National Cancer Act Of its past chairs, the longest serving was Benno Schmidt, an investment banker, senior drug company executive, and member of the Board of Overseers of the Memorial Sloan-Kettering. He was followed by the late Armand Hammer, chair of Occidental Petroleum, the company responsible for Love Canal and numerous other pollution disasters, and a major manufacturer of carcinogenic chemicals.

Such conflicts of interest explains to a large extent why treatment, not prevention, has been and still is the cancer establishment's overwhelming priority. Of a $2 billion budget in 1992, NCI claims to have allocated about $646 million or 30 per cent to "cancer prevention". Included in the "cancer prevention" budget was allocation of some $335 million • 17 per cent of the total budget • for "primary cancer prevention". But only minimal funding - $60 million at most - has apparently been awarded for research and interventions into avoidable carcinogens in air, water, food, home and the workplace (with the exception of wide-ranging smoking prevention programmes); only one per cent of the overall $2 billion budget is earmarked for research into occupational cancer. No significant funding seems to have been given for efforts to reduce such avoidable exposures.

Cancer, Life style and the Environment

NCI reluctance to address the issue of environmental carcinogens typifles its "blame the victim" approach to the causes of cancer. In this simplistic and sometimes self-interested view, personal habits and lifestyle, not industrial interests, are held responsible for cancer: prevention concentrates on anti smoking campaigns, for example, rather that curbing more general pollution in the workplace and the environment.

The NCI's estimates of the causes of cancer are largely based of an obsolete analysis of trends in cancer mortality from 1933- 1977. Even when it was first published in 1981, the analysis was criticised severely by leading independent US auth orities for its misleading statements on the causes of some, if not most, cancers and for its preoccupation with blaming tne victims for faulty lifestyles, while trivialising or ignoring *the* role of avoidable exposure to in dustrial carcinogens. The report concluded, for example, that "there is no evidence of any generalised increase in cancer mortality other than that due to tobacco." This conclusion was reached by excluding from the study consideration of blacks (because of the alleged unreliability of the statistics) and people over the age of 66 • the very groups in which more than half of all cancer deaths have been reported - and by incorrectly ascribing lung cancer almost exclusively to smoking. The study was also devoid of any cited quantitative scientific

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data, apart from that for smoking, for which the confounding variable of occupational exposures was completely ignored.

According to Doll and Peto of the Cancer Establishment, diet causes 35-70 per cent of cancers and smoking 30 per cent. Other causes, such as alcohol and sunlight, brought the total up to 96 per cent, leaving a balance of 4 per cent to occupational causes, This tenuous hypothesis flies in the face of evidence:

* Over the last decade, a plethora of new studies have identified numerous products and processes as carcinogenic, including cancers in a wide range of organs, notably the brain, bladder, kidneys and bone marrow.

* Based on exposure data, the US National Institute of Occupational Safety and Health (NIOSH) has estimated that approximately 11 million workers are exposed to occupational carcinogens.

. In late 1981, Peto backtracked and admitted that, "Occupational factors are likely to account for...a large percentage eg. 20-40 per cent of all US cancer. Even low estimates represent large enough absolute numbers of deaths to justify both intensive research and political action... A mere 2.5 per cent of all US cancer deaths would represent some 10,000 deaths per year."

• Of 37,000 cancer deaths each year in New York state, an estimated 10 per cent are due to occupational exposures. The same percentage applied to the US as a whole gives an annual mortality rate of 50,000.

The Brotherhood

The following table was published in the AERB Newsletter; the official organ of the Atomic Energy Regulatory Board.

Cancer Risk Factors in Dally Life	
Diet	33%
Tobacco	31%
Viral Infection	10%
Sexual	7%
Alcohol	4%
Industrial Occupation	4%
Hereditary	2%
Environmental Pollution	2%
Environmental & Medical Radiation	1%
Additives	1%
Unknown	5%

Based on E.H.Rosenbaum's "Can you prevent Cancer".

"In advanced countries the dose due to medical procedures are generally high unlike developing countries. Even in these countries background and medical radiation together possibly causes just one cancer out of every 100 cancers."

The above is a fine example of the "brotherhood"—the network of interest groups. Thus, we have the cancer establishment, basically saying that cancer is your own fault due to wrong diet, smoking, alcohol, sex, heredity, what have you, and the nuclear regulatory establishment— whose stated purpose is to protect the public from "unnecessary" exposure— then using these "findings of perts" in trying to imply that pollution general and certainly radiation are n cause for worrv.

By the year 2030, it is estimated that asbestos - the single most important known occupational carcinogen - will have caused some 300,000 cancer and other deaths, including 60,000 non smoking related mesotheliomas (cancer of the chest of abdominal linings). Such assertions negate the continuing assertions by Doll, on whom the NCI still unaccountably relies, that asbestos is responsible for only a "few cases of mesothelioma"

• Over 20 US and international studies have identified parental exposure to occupational carcinogens as a major cause of which has increased by 21 per cent since 1950.

Reforming the NCI

The complex web of vested interests described above limits the feasibility of implementing the long overdue reforms of the NCI. However, pressure for reform is growing. A statement criticizing federal cancer policies, released in February 1992, was signed by 68 prominent experts in the fields of industrial medicine, carcinogenesis, and public health. Similar criticisms need to be levelled at the cancer establishments of other countries.

Prof. Samuel J Epstein
The Ecologist Sept I Oct 1992

This is an edited version of an address given by Professor Epstein at the May 1992 meeting of the National Cancer Advisory Board. A complete referenced version is available with The Ecologist. We have included this in Anumukti since radiation is one of the most potent carcinogens, and also because the cancer establishment in India is no better. Famous oncologists have lent themselves to spreading disinformation regarding effects of radiation and the tuberculosis detection programme could be leading us to a position where like mammography we would be creating a cancer epidemic in the future.

The Turkish Turmoil

Even as early at 1987, the health consequences of the Chernobyl disaster were apparent in Western Turkey, according to the German Magazine *Psychologic Heute.* This was the area which was most affected by the radioactive fallout from the accident There were large number of babies born during that time with deformities, especially to mothers who were in their second month of pregnancy when the accident occurred. The most dramatic was the case of the village of Diizce, on the western coast of the Black Sea, where, in November 1986, ten babies were born with their brains outside of their skulls—an extremely uncommon condition. Recent reports indicate that the number of abnormal births has quadrupled in the city of Trabzon, since 1986.

A press report dated 13 March 1992 from the semi-official Turkish press agency "Anatolia" states that the Turkish Government is planning to bury 14,000 tons of radioactively contaminated tea. The report adds that 44,000 tons of tea have already been buried by the authorities.

However, at the time of the accident, the Turkish government was engaged in a programme of massive disinformation. A month after the accident the minister for industry, referring to people who pointed out the dangers of radioactive contamination, called them "godless persons". "A little radioactivity is good for the body," he said. The then Prime Minister (and the present President) Turgut Ozal, claimed that radioactivity was good for male virility. And both the politicians got themselves photographed drinking the supposedly contaminated tea in a propaganda bid to show how 'harmless' it actually was.

The government of Turkey at the time, tried all the tricks it knew to deceive the people. The state owned tea company, the distributor of the contaminated tea, printed 1985 as the year of production on packages containing tea that was harvested in 1986. Selman Kinaci, the head of the Institute for Nuclear Science, now admits that they found radioactivity in the range of 50,000 to 60,000 Bq/kg which is more than a hundred times higher than the 'permissible' limits. However, at the time the scientists were not permitted to publicise radioactivity measurements and were threatened with disciplinary measures.

Unable to sell contaminated hazelnuts abroad, the government carried out massive distribution of the nuts in schools and to army recruits during 1990-1991. The government also exported 4-5 tons of hazelnuts to Russia.

Now, the consequences of Chernobyl on Turkey are becoming obvious. The leukaemia rate is twelve times higher than before. Gunduz Gedikoglo from the Faculty of Medicine at the University of Istambul and the head of a foundation for children suffering from leukaemia, says that, "We have looked at all potential reasons for the unnatural increase in leukaemia rates, and the only reason is Chernobyl."

The current government is using the then government's response to Chernobyl as a stick to beat the "Motherland Party", which was then in government. As more and more facts about the whole scandal become known, hundreds of charges are being levied against people responsible. Headlines in Turkish newspapers read "Chernobyl criminals to court!"

Anatolia news agency also reported recently that Turkey would soon have its first nuclear power plant. Yalcin Sanalan, the president of the Turkish Atomic Energy Agency said that "It is important to eliminate the psychological fears in Turkey caused by Chernobyl."

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While the increase in number of deformities and leukaemia (12 times greater than before) are obvious and are admitted by the present government of Turkey, which uses these tragedies as a stick to beat its political opponents who were the government at the time of Chernobyl accident, it too wants to take Turkey down the nuclear path. Yalcin Sanalan, the president of the Turkish Atomic Energy Agency **said** that "It is important to eliminate the psychological fears in Turkey caused by Chernobyl."

Public Awareness at Kalpakkam

Bhopal, Chernobyl, Three Mile Island are names which recall scenes, of horror and panic caused by large scale industrial disasters of recent past. It has been claimed, by nucleocrats among others, that the reason for the large scale devastation and loss of life involved in some of these accidents is due to the fact that people were not prepared in advance for the accident and its consequences. Of course, after any such accident, the first declaration from the authorities that one hears is that such a disaster is inconceivable in 'our' system. That ritual done, the next pronouncement one hears is that 'lessons' are being learnt from the catastrophe and the misfortune is some kind of a blessing in disguise, since it would mean that there would be better preparedness for future accidents. The accidents we have mentioned took place quite a long time back, so that one would expect that at least now, after a period of so many years, we are in fact well prepared to deal with any kind of nuclear calamity. In fact, after the Chernobyl disaster, an "emergency preparedness plan" was prepared and a number of drill and exercises involving the nuclear plant authorities and the civil authorities have already taken place in all operating nuclear plants in the country. The first time such exercises were undertaken in 1988, there was total confusion and panic. (See Anumukti vol.2 no.2/3) However, now that a number of such exercises have been conducted, the time is probably right to take stock, and see if the people in areas surrounding nuclear power plants are aware of their role in an emergency.

Makkal Ariviyal Iyakkan (People's Science Movement, Tamil Nadu) have recently undertaken this task, and conducted a survey of villages around the Madras Atomic Power Station (MAPS) at Kalpakkam in Tamilnadu. Their report is entitled "A Sample Survey On The Peoples' Preparedness in Case Of An Emergency And The Economic Effects .On The People Around Kalpakkam Nuclear Power Plant". Besides including the results and analysis of the survey carried out in 1992, the report contains additional information concerning the nuclear industry in the region and the perceived economic benefit to the population of the region.

Alms

- **To investigate the awareness of local people to the health and safety issues surrounding nuclear power and to gauge the potential reaction of people in case of nuclear accident**
- **To obtain the opinion of the local people as to their current and prior economic situation in order to gauge the actual effect of a capital intensive energy production industry on the people living in the area.**

Methodology

The Kalpakkam plant is located midway between Madras and Pondichcry, about 80 Km south of Madras, on the coast of the Bay of Bengal in Tamil Nadu. It has two reactors operating for the last 9 years. Amongst the villages which are spread all around the plant, are a number of fishing hamlets. The area experiences cyclonic storms almost every year during the winter monthi.The survey covered 36 villages and 21 PanchayaU within a 16 Km radius of the plant 369 people were surveyed either by individual or group interviews. Amongst the participants of the survey 12% were female and 88% were male. The caste distribution of the survey participants was 1.6 percent forward castes, 68.8 percent backward castes and 39.4 percent scheduled castes and tribes.The educational qualifications of the participants varied from illiterate (32%) to above 10th standard (6.7%). The survey was conducted only amongst adults with 27% aged between 18 to 26 years, 33% between 25 to 36 years and the rest 40% being over 40 years of age. Special efforts were made to contact panchayat chiefs. The caste composition and the educational distribution of the survey participants reflects the overall distribution of caste and literacy in the area.

RESULTS

The survey tried to gauge people's knowledge on two aspects

- **Radiation and its Effects**
- **Knowledge regarding what action to take in case of an emergency**

Report of an Interview with a Panchayat Chief

Below we reproduce verbatim an interview with a panchayat chief to illustrate the level of ignorance amongst these functionaries. M.A.I. stands for the interviewer, while P.C.denotes the panchayat chief. It is well to keep in mind the fact that these people form the main link between the authorities and the people and who are expected to be the main source of information and leadership in an accident situation.

MA.I. : How will you get the message of a nuclear mishap?

P.C.: I will get the message from the Village Administrative Officer.

M.A.I.: Where does he stay?

P.C.: His permanent address is in Tirukalikundram, which is about 10 kms from here.

M.A.I.: Then how can he inform you in the evenings or the nights?

P.C.: (no answer)

M.A.I.: Where will the bus to evacuate people come?

P.C.: It will come near the temple tank.

M.A.I.: What will you tell the people?

P.C.: I will ask all of them to assemble near the indicated place.

M.A.I.: Is there any shelter there?

P.C: No.

M.A.I.: How many buses will come there?

P.C.: Two or three buses.

M.A.I.: What is the population of this village?

P.C.: There are about 400 houses with about 1,000 adults. Total population may be about 2,000.

M.A.I.: Where will they take you?

P.C.: To some place near Katankalthur, which is about 60 kms away.

M.A.I.: How long do you think it will take to evacuate everybody?

P.C.: Well, I really don't know, but we can calculate. A up and down trip takes about 3 hours. In one trip about 70

P.C.: We are the only ones. Who else?

M.A.I.: Docs that mean that you will not leave this place for two days till the last person has boarded the bus and all the people have evacuated?

P.C.: Urn...!

M.A.I.: Where will people stay till they board the buses?

P.C.: Why? They have to wait here for the bus.

M.A.I.: Weren't you told that it is better to wait indoors till the bus arrives?

P.C.: 1 did hear something like that. But it is not practical. People will be panicky and would want to board the bus at the earliest. How is it possible to expect them to stay indoors ?

MAJ~ What about your food?

P.C.: Food! We have no choice. We will eat whatever is available. We hope the government will help us.

M.A.I.: What about the water?

P.C.: We normally drink the water from that well nearby.

M.A.I.: What about vegetables and milk?

P.C.: We can't afford to buy vegetables and milk from outside. We eat what we grow.

M.A.I.: But will you continue to use the water from the well and the locally grown vegetables and milk even after the accident?

P.C: Yes, of course. Why not?

MAX: Were you not informed that all the products lying outside have a fair chance of getting contaminated and

On the basis of the replies received, the participants were characterised as belonging to three categories:

- Those who were unable to give any coherent answer at all to the question were classified as ignorant (53%).

- The second category was "knows something but not clear". Thus anybody who said that radiation can cause health hazards was put in this category (34.5%).

- Any body who said that radiation can cause heath hazards when limits are exceeded, and this has a genetic effect, was classified as "possesses minimum clear knowledge" 12.5%) (*/ would not agree with this definition - Editor)*

Only 12.5% of participants fell into the minimum clear knowledge category. Of these NONE were women. Most were forward caste and with higher qualification. Age and distance had little bearing on the knowledge base.

Similarly, people were categorized in the same three categories depending upon their knowledge of what to do in case of an accident. The percentage in the "Ignorant" category—(No coherent answer) was 68.8%. 26.6% of the respondents answered "We have to run. Government will help us. They will tell us what to do." Only 4.6% of the respondents who said that, "We should stay indoors till help comes. If at all we move in a vehicle we should move in the opposite direction to that of the wind," can be considered to possess minimum clear knowledge.

In this sample the knowledge base was found to be independent of qualifications or age. It is interesting to note, however, that none of the participants in either the highest qualification category or the forward castes possessed minimum clear knowledge.

The surveyors note that the number of people who clearly know what to do in an emergency is dangerously low. The number of people who "know something but are not clear" are as vulnerable as the totally ignorant lot since the probability that in an emergency they would take the wrong step is high.

The number of people who clearly know what to do in an emergency is dangerously low.*

The organisers of the survey made "special attempts" to meet with Panchayat Chiefs. See Box for a verbatim report of a conversation with a Panchayat chief.

The report states that, of the four Panchayat Chiefs interviewed, "none of them knew that they have to stay indoors. A wet cloth on the nose will help, outside uncovered food and vegetable should not be used, only water kept inside should be used ... , where buses will come and how they will regulate people to buses, how much time or how many days it will take them to evacuate, what will be the facilities that will be provided, who are to be evacuated first"

Economic Aspects

Besides focussing on emergency preparedness, the survey also put question to the participants on their economic well-being due to the plant It is generally claimed by the governments that such mega-projects 'develop' the local area, and create new employment opportunities and 'elevate' the general condition of the people. About 700 crore rupees of public money were spent to set up the MAPS complex. Since there are about 3,500 permanent employees and about an equal number who work as casual labourers on a temporary basis, this works out to about Rs 20 lakhs spent in the creation of just one permanent and one temporary job! In order to focus on the benefits received and economic penalties that might have been paid, by the local populace, the following queries were put to the respondents:

- 1.Whether there was any change in their income due to the plant

- 2. Whether they or their family members had got any jobs (government/ contract /other)

- 3.Whether they felt that the cost of living in the neighbourhood had increased due to the high income employees of the plant

It became apparent in the survey that the first two points are dependent on the distance between the home and the plant. Those living close to the plant got considerably more 'contract labour' work. However only 2.2% of the people surveyed very near the plant got permanent Group D (sweeper/helper) jobs in the atomic energy establishments. And from the data it seems that their age and qualification has not given those living near the plant any advantage in obtaining permanent jobs.

Only 15% of the respondents had obtained contract labour jobs. And these jobs have not affected their economic status in any way. Of the people who haye got jobs, most were from the less educated and the scheduled castes. The survey concludes that "the scheduled castes who are normally farm 'bonded' labourers, prefer to come out and work as coolies for marginal or no economic benefits. This in a way gives them freedom from their age old feudal masters, but only to serve their new masters." The report

goes on to say that this appears to have 'loosened the traditional feudal grip on the harjjans."

Not a single woman in the survey had a permanent job in the government or allied establishments.

During the course of the questioning other relevant information also came to light "It was found that many of the people whose lands were taken for the project were promised jobs but were not given them. They feel they have been deceived and show their 'certificates of preference* given by the Thasildars with anguish and despair."

The authors of the survey conclude that "the local economy has been imperiled by an increase in the cost of living and the accentuated economic differentiation." They feel that "Rs 700 crores of public money has brought in only economic deprivation along with high risk dangers to the local people. All the so-called 'economic benefits' have accrued only to those already better off or to the salaried classes coming from other parts of the country. The response among the 'beneficiaries' (those living within 5 km from the plant site) to a proposal for a new reactor in the area was vehemently opposed to the whole idea.

In the area near the plant and also in the area near the township for the workers of the plant, people overwhelmingly believed that the cost of living had risen since the construction of the plant And a comparison with villages 30km away indicated that prices were indeed higher in this region.

Other Information

Besides the survey there is some additional information concerning water usage and salinity resulting from the Kalpakkam plant's massive use and diversion of water. The township has a population of around 20,000. These 20,000 people consume 5.56 million litres of sweet potable water every day. Besides this consumption, the plant itself also uses 6.4 million litres of sweet water daily. This water is pumped from huge pumps installed in the bed of the Pallar river. The location is also the source of water for some suburbs of Madras city like Maraimalai Nagar, Tarmbaram, Pallavaram, etc. This huge extraction of water from a river which has very little surface flow most of the year and none during the summer months, has resulted in a depression of the ground water level by 30 to 50 feet The pane hayat chief of Vayalur village claimed that sea water has already penetrated into the subsoil strata and the resultant salinity has devastated about 100 hectares of land in the area.

It seems that "this technology is totally alien to the local population and hence people are not in a position to even comprehend it".

Makkal Ariviyal lyakkan

"People have a right to know the dangerous activity that is going around them. They also have the right to accept or reject such an activity based on their capacity to comprehend the danger."

Radiation and Chromosomal Instability

ritish researchers Murina Khadim, DA.McDonald, ___ D.T.Goodhead, S.A.Lorimore, S.J.Marsden and E.G.Write of the Medical Research Council's Radiobiology Unit in Oxford have developed evidence that alpha-particle irradiation may cause a previously undetected form of radiation injury. If this finding is confirmed, there would have to be a reassessment of the harm done by alpha radiations, which have been ignored till now for the lack of effective monitoring techniques.

As is well known, ionising radiation, whether gamma, beta or alpha and x-rays, can harm human beings quickly or slowly depending upon the intensity of exposure. Effects can range from prompt death to acute and delayed (days to months) radiation sickness, to long delayed (years to decades) latent cancers, and other mutagenic breakdowns (generations).

Current radiation safety standards are in large part based on statistics for external radiation. These standards assume that high-energy penetrating radiation (such as gamma or X-rays) is significantly more dangerous than alpha radiations "which can't penetrate a piece of paper".

What the British researchers' experiments suggest is that alpha particle radiation will damage a cell even when it misses the genetically significant DNA in the cell's nucleus. Heretofore, the expectation has been that radiation damage to genetically significant DNA would produce a clonal (identically repeated) aberration, whereas radiation damage to any other part of DNA was previously thought to be a phenomenon that was effectively repaired, removed, harmless, or that did not occur. The British research suggests that radiation damage to the non-genetic DNA may in several generations, produce a variety of abnormalities, not just the single, identically repeated transformation resulting from damage to the genetic DNA.

Each cell in the body consists of a nucleus in a body of fluid called cytoplasm. An alpharparticle, traversing a cells cytoplasm but bypassing the cell's nucleus and its contained DNA, may cause a physicochemical derangement of only the cytoplasm. This disorder of the intracellular metabolic environment may, secondarily, disturb the nuclear DNA and cause a consequent "chromosomal instability*.

Although about 80% of the cells targeted are likely to be killed outright, some will survive to replicate. These may show no sign of their altered internal state for many generations. When they do, however, their appearance shows varied and multiple alterations, rather than the single repetitive clonal pattern seen in surviving generations of cells subjected to low energy transfer gamma or X-ray irradiation.

This variety of chromosomal change in daughter cells after alpha irradiation makes the nature of the radiogenic effect of a single impingement difficult and doubtful, if not impossible, to identify or predict-not merely for a given cell or set of cells, but especially for a total organism such as a human being. Only the pattern of new and diverse changes not seen under previous low level irradiations confirms the phenomenon and its interpretation.

The Prevailing Theory of Carcinogenesis

Briefly described, cancer formation is understood to be a process of initiation of a normal cell to abnormal growth, known as transformation. Growth is manifested by cell reproduction. Only after one or more such "clonal" cell replications is completed, does the cancer process, or expression become fixed or established. Clinical appearance in the form of a tumour will appear some months or even years later, depending on many promotional, hereditary or immune, latency and inhibitory factors. Such transformations may be both genetic or epigenetic. In a genetic process, the "human cancers occur as a result of changes or damage produced in the chromosomes of DNA of cells. Every irradiated cell is in-

All we have been told of the hazards of alpha radiation has been minimised by the assurance that exposure is very slight. Now this study suggests that deleterious changes can be expected, belated and variable. It suggests that such changes will be inherited.

itiated. Only a very small proportion produced transformed colonies (tumours)." In an epigenetic process of cancer formation on the other hand, other changes and damage are presumed to result from "regulation of DNA activity" by physico-chemical influences outside the genetic DNA sequence and structure, hence the term epigenetic.

The "chromosomal instability" phenomenon due to alpha radiation may be such an epigenetic process. Its demonstrated durability and persistence after many cell replications gives one pause to reflect on species implications. The potential for both metabolic and genetic cellular alterations and aberrations are vast, diverse and immeasurable.

Cancer is the most readily identifiable human disorder caused, contributed to, or facilitated by low level ionising radiation, but cancer and deaths are not the only outcomes of chromosomal instability.

Implications

Initiation of cellular transformation leading to cancerous growth may occur due to low or very low ionising radiation without the invasion of the cell nucleus or a direct impact on nuclear DNA.

Chromosomal instability materialises visually only some generations after the non-lethal radiation impact on the surviving cells.

While only 15-20 per cent of the cells exposed to the study's "very low doses of alpha radiation" survive, nevertheless 60 per cent or more of the surviving cells will show changes resulting from the exposure.

Heretofore, everything we have been told of the hazards of alpha radiation has been minimised by the assurance that exposure is very slight Now this study suggests that deleterious changes can be expected, belated and variable. It suggests that such changes will be inherited and epigenetic, likely to show up as physical changes in later generations. Further, the study suggests that even very small exposures at the subatomic level are cumulative.

This points towards the conclusion that any man-made isotope has an impact on the global ecology, sometimes for millennia. Americium-241 is a case in point: It is used in smoke detectors for homes and commercial buildings. Only 1 micro-Curie of americium-241 is used in each smoke detector, but there are some 12 million of these devices distributed each year in U.S.A. alone. With a half-life of more than 400 years, americium-241 will remain potentially destructive for a period almost as long as human history to date.

Radiation Events Monitor
Center for Atomic Radiation Studies
P.O.Box 1036 Cambridge MA USA.

The Whitewasher Extraordinary

R. Ramachandran, the science editor of *The Economic Times* is something of a rarity. He belongs to an almost extinct breed: the pronuclear activist Now, there might be many who hold pronuke views, but they are not active. Even amongst the employees of the Department of Atomic Energy, there are many who are not only not active, but also not pronuclear. They are just doing a job — a technician's job or a scientist's job or an administrator's job, with no clear conviction as regards the nuclear issue. Ramachandran is exceptional since although he is not on the nuclear payroll, he has through his articles done more than anybody else in trying to resurrect the proverbial figleaf to cover nuclear mismanagement and excesses.

In my view, having somebody like Ramachandran in the pronuclear corner, is an advantage, since unlike the paid spokesman in the nuclear lobby, he is both knowledgeable and has the ability to express his views with clarity. Thus, his contributions help to raise the level of debate from the rock-bottom of name calling and appeals to patriotism that is the staple from the 'authorised' members of the nuclear establishment

-CIRUS LEAKS—No cause for alarm" is his latest offering which was published in *The Economic Timet* of 19th December, 1992. Normally, it would be best to reply to such articles by writing letters to the editor. Unfortunately, I first saw the article just yesterday, (24.2/93) when Ashok Kumar sent a cutting from Bombay. It is already too late to reply by writing a letter to the editor, and moreover I want to bring this topic up in *Anumukti* so that readers can become aware of the mixture of half-truths and deliberate omissions that forms the pronuclear argument I am not reprinting the article in full over here, since for one it is too long and secondly I feel that we do give more than enough space for the pronuclear point of view. What I will do instead is to quote illustratively from the article as a

specimen of the Ramachandran style of disinformation. All those who are interested can of course look up *The Economic Times* of 19.12/92 as well as *Anumukti* Vol.6 No.l. for a reprint of the original article by Rupa Chinai in *The Sunday Observer* which first highlighted the problem. Ramachandran states,

'While the media does deserve the credit for highlighting the incident, unfortunately such events tend to be projected with alarmist hues. For the public at large, scientific terms and units of radioactivity and its exposure such as curie (Ci) or bacquerel (Bq), rod or Gray (Gy), rem or Sievert (Sv) do not mean much unless the numbers are put in the proper perspective."

After this fine preamble, Ramachandran then promptly proceeds to take advantage of the public's ignorance of these units by piling upon his readers heaps of data in different units. Thus we have

"December 14, .1991 - Radioactive water found to be leaking into the excavated pit. The water sample was found to have an activity of 40 Bq/ml. (One bacquerel corresponds to one radioactive disintegration per second—human body contains 4200 Bq of pottasium-40, i.e. 15 million distintegrations per hour, 455 Bq of rubidium-87 and about 2900 Bq of carbon-14; Milk contains 45 Bqll of potassium-40.)"

Along with this Ramachandran also gives two tables. One titled "Median Values of Cs-137 levels" and the other "Radiation Doses to public through food". The first gives values of cesium-137 activity in sea water, marine organisms and solar dried salt for various years from 1983 to 1992. The units in these values are mBq/1 and the values range in the case of sea water from a low of 40 in 1991 to a high of 836.2 in 1984.

Let me borrow Ramachandran's own words and put these numbers in "the proper perspective". The impression one is apt to get from a reading of the article is, why are the antinukes in such a flutter over a mere 40 Bq/ml whereas the human body contains 4200 Bq of radioactive potassium, not counting the rubidium-87 and the carbon-14. What Ramachandran so conveniently fails to mention is that the human body in question is that of an adult male with a hypothetical weight of 70 kilogrammes. Thus the equivalent number in the same units (Bq/ml) for the radioactive potassium in the human body is 4200 divided by 70,000 which is equal to 0.06 Bq/gm. (Since the human body consists mainly of water and one millilitre has a mass of one gramme there will not be any significant error in replacing Bq/gm with Bq/ml.) Or in other words, an amount of sea water lying on the grounds of the Bhabha Atomic Research Centre equal in weight to an adult human being would have given off not just 15 million but 10,000 million disintegrations per hour.

However, even this is not the whole story. It is just the beginning. As the table headed median values of Cs-137 levels mentions, the radioactivity of sea water in the year 1991 was 40 mBq/1. Since the water was leaking from a pipe which was bringing in sea water into the complex, the radioactivity of the water in the excavated pit ought to have been 40 mBq/1. Instead it was 40 Bq/ml. The small m, is a factor of a thousand which instead of dividing is multiplying the coinci den tally identical value. Thus, the amount of radioactivity in the water leaking from the pipe was a million times more than what it was in the sea from whence it came. The question is how come?

The cause of this extraordinarily high value of activity was due to leakage of nuclear waste from another pipe which had contaminated the soil of the whole area to a dangerously high level and the water leaking from the sea water ingress pipe had picked up some of that activity. The soil in the area was contaminated to the extent of 1,000 to 60,000 Bq/gm. In other words the soil was a thousand times more contaminated than the leaking water which itself had a million times more radioactivity than the 'natural' radioactivity in the sea. Putting all the numbers in the same units allows the concerned readers to form their own perspective, rather than relying on the "proper perspective" of interested partisans.

I will give just one more example of Ramachandran's selective use of facts and advocacy style of journalism. Consider this

"To contain the radionuclides a vermiculite layer of 30 cm followed by fresh soil, has been used to fill the pit. This is expected to retard the migration of the radionuclides. The radiation field at this spot after filling was found to be 0.4 microsievert I hour. A person working at that location for 40 hours a week for 50 weeks a year would be exposed to a dose of 0.8 mSv. The annual dose limit for a radiation worker is 20 mSv."

However, this needs to be read in conjunction with the following

"December 20 1991—Entire area surveyed. High radiation field on pit top (with dose rate of about 300 millirem/hr) detected requiring remedial action.

And also this

"Based on the radioactivity level ratios of the short-living Cs-134 and long-lived Cs-137, investigations have concluded that the leakage had been taking place for some years at least. Since the

leakage woe at a totally unexpected spot which is not under routine surveillance it remained undetected, according to Atomic Energy Regulatory Board."

Now let us do the same exercise as Ramachandran does and estimate the annual dose to a worker who might have worked at the spot for 40 hours a week for 50 weeks a year for the unknown number of years before the leak was detected, because it "happened at a totally unexpected spot".

1 rem is a hundredth of a Sieved, and thus 300 millirem/hr is equal to 3 millisievert an hour or 3000 micro8ievert an hour. Thus, the yearly dose comes to 6000 millisievert (mSv) which is merely 300 times the annua) dose limit for a radiation worker.

Of course one needs to remember that this is an academic exercise. Nobody was working at the spot which happened to be the lawn behind the CIRUS reactor. However, people did loiter there and the dose that they received at the place was in addition to the presumably 'monitored' dose they received during their regular work. The mora) of the story seems to be: Do not loiter while at work in the Bhabha Atomic Research Centre. Unexpected places can kill you due to unexpectedly high radiation levels.

These numbers indicate a very different picture than the one Ramachandran has tried to present. They indeed constitute a cause for alarm. However, Ramachandran's main thrust is different He is basically trying to tell his readers that although there has been an accident within the BARC complex its implications for the people outside are minimal and the general public can rest content that

these "anomalous radioactivity releases have had no adverse impact".

In his own words,

The most important concern i§ whether the leakages have led to any appreciable increase in the radioactivity levels in tea-water and marine organisms. (See Table 1) The BARC conducts tests on tea water, tolar salts and marine organisms of over a hundred samples every year collected from 18 locations. These tests have demonstrated that during 1992 there has been no detectable increase in the concentration of the radionuclides. "

For all anybody knows, this contention may well be true, but how is one to know. It might have so happened that for many years past leakage in the radioactive waste carrying pipe has deposited this waste in the vicinity of the reactor and has mercifully not carried them out to sea. Unfortunately, the source .of all the reassuring figures and tables that Ramachandran presents is BARC itself-an interested and discredited party, as even Ramachandran would agree.

However, Ramachandran has another argument to assuage public fears in case these BARC generated numbers fail to impress, and this ace up the sleeve is that famously (in their own words) "independent* body, the Atomic Energy Regulatory Board (AERB).

"Even such a low-index event cannot be hidden by the BARC authorities even if they wanted to, because there is a regulatory authority to which they are answerable—the Atomic Energy Regulatory Board. One would have been accused of being extremely naive to swallow this some years ago when the autonomy of the Board was always in doubt. But now the Board does appear to have come into it own.*

As a proof of the Board's independence, we have in 14 points bold highlight the following

In July, AERB wrote to the BARC director expressing his serious concern over sub-soil contamination.

Suffice it is to note that in this very instance of the leaking pipe in BARC, the reactor authorities showed their contempt for AERB directives and restarted the reactor on February 5th 1992, at a time when the pipeline had not been repaired, while the Reactor Safety Committee had asked them not to start the reactor till all the leakages in the pipeline had been isolated and repaired. This disdain of AERB will continue to be a regular feature of DAE facilities till the body becomes truly independent and takes its regulatory role seriously and not as a part of "allaying public fears".

The nuclear establishment in this country is a huge operation and has a large number of paid propagandists, public relation officers media specialists and the like. Over the years, they all have managed through persistent deception and due to their total disdain of the concept of public accountability, to have lost their credibility. Nobody gives two hoots for their 'cooked' data. Thus, their need for a supposedly 'independent' expert like Ramachandran is obvious. It is a pity however, that Ramachandran has let his obsession with the nuclear dream to get the better of his scepticism which ought to be the bedrock of any scientist.

Surendra Gadekar

February/March 1993

Anumukti for Peanuts!

Two hundred and fifty rupees may not exactly feel like peanuts. But in these inflationary times with the government dedicated to squandering our money, it may not be long before even peanuts may not be available at this amount. But Anumukti would be if you make a lifetime subscription, (just Rs 2501-) right now. (This offer is valid only within India.) This is your last chance of getting Anumukti at this special rate. Starting with the next issue, the lifetime subscription rate will be Rs 5001-

According to a television documentary broadcast late last year,it was common

Robotics Nuclear Style

practice in the first East German nuclear reactor at Rheinsberg (70 km northwest of Berlin) to send people into the conduit pipes of the primary coolant system to check for welding cracks and possible leaks. During the inspections, the water in the pipes was released and the interiors of the pipes were cleaned by a chemical substance to remove radioactive particles. The workers some of whom came from a Yugoslav firm, climbed into the pipes. A rope was attached to their feet so they could be pulled out. No figures have been released regarding the amount of radiation the workers were subjected to in this procedure. Robot cameras were not then available in the GDR. But since the emergency core cooling system was not sufficient, a failure of the primary cooling system would have proved fatal. Thus inspections were obviously very necessary and important. The Rheinsberg Reactor—a 70 MW reactor of Soviet design—began operation in 1966 and was shut down in June 1990. It is being prepared for decommissioning, which is expected to last till 2009 and cost an estimated 800 million German Marks.

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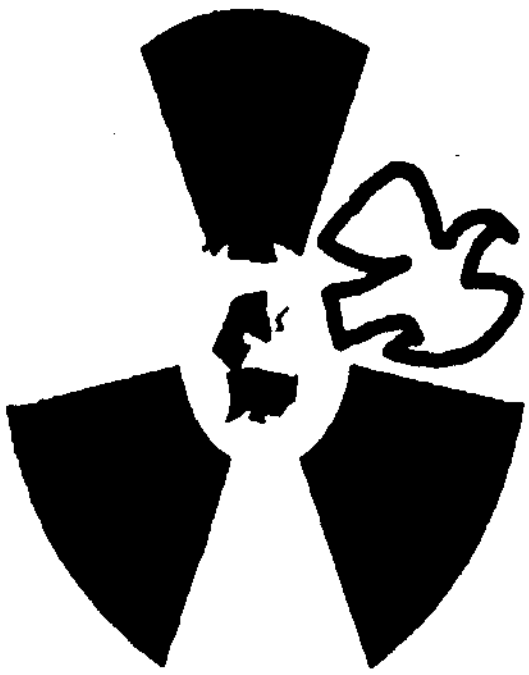

ANUMUKTI

A Journal Devoted to Non-Nuclear India

Volume 6 Number 5 April / May 1993

A Special Issue On

RAWATBHATA

From The Editor's Desk

h ta survey took p h September to 2 ber, 1991. It is now May 1993. A report which **we had** expected to complete in a few **months** at **the** most has taken the better part of two years. Yet, the task is not complete. What we present here is in the nature of a preliminary summary of the main conclusions. By preliminary, we do not mean that the contusions drawn are tentative and subject to change on further analysis. The conclusions are firm. But a final report would require a large amount of detail, which for reasons of economy of spare and also because we felt that it would not be of great interest to most readers of *Anumukti,* we have omitted from this narration.

We expect the full report to run to well over 100 pages. It would contain all the data along with various cross-tabulations. It would need illustration and we have a number of photographs for the production. The production costs of a properly brought out document are likely to be high. It would require a great amount of our time and effort. Although most of the analysis is already complete, the writing of the full report remains a formidable assignment. Before launching ourselves into this task, we would like to know if people are interested in the outcome. So, please write a letter to us letting us know if you are interested in buying a copy of the report. If we get more than a hundred advance orders we would certainly produce the report. In case, not many are interested, we would publish the material as a series of technical papers in various journals.

There remains the question of the language of the report. We feel **that** the information most **intimately concerns people** who do not know **English, but most people** who have the time to devote to read such reports prefer English. If we get even 25 orders for **a** Hindi version, we would **be** very happy to bring out a Hindi **version** also.

Conclusions of the Health Survey of Villages Near Rawatbhata

- An extraordinary rise in congenital deformities
- Spontaneous abortions, still-births and one day deaths **of** new **born** babies significantly higher
- Significant increase in chronic diseases especially amongst the young. No differences in acute infections
- Solid tumours significantly higher
- A difference of more than 11 years in the average age of people who have died in the last two years
- More cancer patients and cancer deaths in villages near the plant
- Significantly lesser number of electrified household and pumping set connections near the plant

Supreme Court Asks the Government to Reconsider Kaiga Atomic Power Project

Final hearings are in progress in the case filed by antinuclear friends in Karnataka against the Kaiga Atomic Power Project in the Supreme Court. In an interim order, the Court has asked the Government of India to reconsider the project.

Kaiga is **the** only **place in the world where a nuclear power plant is being built in the midst of a tropical rain forest. The project is a specially heinous crime against the environment.**

The case has been an expensive proposition. Please donate mogey generously to help defray the costs. Send **your contribution to**

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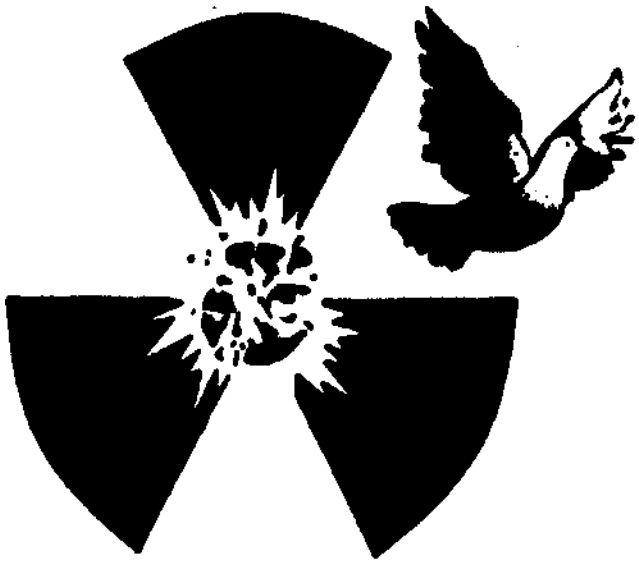

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Faustian Bargain

Nuclear technology was called "A Faustian Bargain" by AIwyn Weinberg, one of the pioneers of the field. In Faust, Mephistopheles does fulfil his part of the bargain What about in Rawatbhata?

The people of the area around Rawatbhata never made any bargain with anyone. The bargains were made in their name, in Delhi and Bombay and Ottawa. The people have certainly paid a heavy price. We would call it an unacceptably heavy price. But, what have they paid it for? What difference has this temple of modern India made in the life of Dhapo Bai of Malpura, or Bhanwarlal Bhil of Tamlav?

We must remember that RAPS was not the first encounter these people had with development. Before RAPS, there was the Rana Pratap Sagar Dam. Some of the people presently living in the villages that we surveyed are refugees from that first bout of progress. There is no doubt that the one thing that has been achieved is the destruction of the traditional way of life. We found that whereas the residents of the distant area do find employment within their villages, the people in the proximate,area are totally dependent on RAPS. Not only for employment, but also as a market for their produce and services.

Modern development means concrete things to people. Things like better roads, telephones, schools, better health care facilities, pot* able drinking water for which one doesn't have to walk for an hour, electric lights, irrigation, etc. We found that for any of these criteria, the distant villages were either distinctly better off or certainly no worse than the villages near the nuclear power plant. We have already, in the results section, commented on the fact that while less than 20 percent of the households in the proximate area had electricity, the number of such houses in the distant area was 52 percent. Regarding potable drinking water, the Central Water Commission has given its verdict (page 28).

Let us focus our attention on the health care facilities. Till the time of the survey, there was no primary health centre in any of the five villages. This made it imperative for the villagers to go to Rawatbhata in case of any medical emergency. There were only two buses in a day plying between the villages and Rawatbhata. (Tamlav in this case is an exception, since it is situated on the main road and is consequently better connected.) Both the buses reach Rawatbhata after the primary health centre there has closed for the day. Of course, there is a modern hospital in Rawatbhata, equipped to deal with any medical problem, but its services are meant only for the 'regular staff of RAPS and not for the hoi-polloi. Casual workers at such times are not considered 'nuclear' workers and certainly not 'staff. In fact, requests by-the'public for admittance to the RAPS hospital are considered as ''attempts to blackmail" (see page 23).

From time to time, there are stories in newspapers of superstitious people who practice human sacrifice in the hopes of finding buried treasure. These stories justifiably fill us with horror not only at the gory deed, but also at the superstition. When will we feel the same horror and revulsion towards the modern superstition of development which requires many more human sacrifices?

Acknowledgements

First of all, we would like to express our sincere gratitude and thanks to the people of Rawatbhata and Rampura areas, without whose unstinted cooperation and help the survey would not have been possible.

Young people, students and doctors from different parts of the country came for the survey, giving their time, and spending their own money. We can never forget their dedication and selflessness.

The help given by Dr Leela Visaria and the Giyarat Institute of Development Research, Ahemedabad in design of the survey was what allowed us to even think of under* taking the survey in the first place. IIa Mehta and Vinayak Dave of this institute were the coordinators of the data collection team and their professionalism was marvellous.

Rajeev, Ratna, Nivedita, and Vidya of the Network to Oust Nuclear En ergy, were responsible for recruiting the volunteers from Delhi. It was Ratna's will to see the survey through which gave us a new impetus at a time when we were feeling rather depressed.. Rajeev and Ratna did so many chores that it would take pages to just enumerate them. The role of Shri Ram Pratap Gupta of Rampura College was crucial. He made all the arrangements at Rampura and also inspired his students to join the survey team. Ms Sudha Hardikar put us all to shame with her apetite for hard work. Aradhana's meticulousness helped us maintain a uniform standard of data col* lection in both areas.

Acknowledgements cannot be complete without mentioning two names from Rawatbhata. They have already suffered so much harassment that they are immune to any further provocations. Jaan Mohammad Saheb not only opened the doors of his hotel to us, he opened the doors of his heart. And more than anything else it was the courage and the perseverance of Shri Ratanlal Gupta—Sarpanch of Rawatbhata, which carried the survey through.

Introduction

During the 1950s and 60s, in the first flush of freedom, development came to the bank of the river Chambal in south Rajasthan. Dams were designed, barrages built, power stations put up. Kota, which used to be a sleepy mofussil town, was transformed into the industrial hub of the region. New townships sprang up. The story that follows is a story of one such 'temple' of modern India located on the banks of Chambal: Rawatbhata, the atomic town. But to bring out into full focus the assorted threads of development, it is necessary to contrast this shining new temple with an old semi-deserted ruin, another habitation just 50 km upstream on the Chambal—the town of Rampura in the adjoining Mandsaur district of Madhya Pradesh.

The "Fall' of Rampura

The first recorded reference to Rampura in historical records occurs in 1434 AD. It is well established that even as early as 1730 AD, Rampura was a prosperous town. It was the capital of a state of 661 villages and had an income of Rs 8 lakhs. However, in the 1750s, its administrative decline started when it was annexed and made part of the Holkar state. Despite this, eighty years later, in 1830s according to Sir Malcolm Hamilton, it was a town of 4,000 houses with a population around 20,000 to 25,000- Its sworda, metal work, wood work and cotton and woolen weaving were famous.

The first major economic shock to this town was delivered by the building of the B.B & C.I. railway line. The railway bypassed Rampura which slowly lost its importance as a centre of commerce and trade. Industrialisation meant the local cottage and village industries were slowly obliterated. All this plus two severe droughts resulted in the first large scale emigration from Rampura area. The population declined by 30% in the three decades between 1890 to 1920.

The second blow to Rampura was delivered by the construction of the Gandhisagar dam on the Chambal. The hinterland of Rampura-the villages whose products were sold in its market-all went underneath the vast expanse of the Gandhi Sagar Reservoir. Rampura's population today is less than 10,000 and the vast beautiful ruins of empty houses and old havelis bear testimony to a glory gone by.

The Rise of Rawatbhata

Rawatbhata, on the other hand is a place which prima facie has prospered under development. Like Rampura, it too is situated near a dam on the Chambal - in its case the Rana Pratap Sagar Dam. But unlike Rampura, its population during the last thirty years has grown The building of the dam was followed soon by the building of the atomic power station complex Rawatbhata was selected as the site for the first pressurized heavy water reactor (PHWR) in India in 1961 and construction started in 1964. Unit-1 achieved criticality in August 1972 and was declared commercial in December 1973. The construction of the second unit started in 1967. It achieved criticality in October 1980 and was declared commercial on April 1, 1981. The station, known as the Rajas than Atomic Power Station (RAPS), is located around 5 kilometers south of the town of Rawatbhata, on the east bank of the Rana Pratap Sagar Reservoir. All this development activity brought construction workers and later engineers, operators, security staff, etc. and their families. Many people displaced by the reservoir flocked to Rawatbhata to try their luck setting up new businesses and providing various services to the burgeoning population. Today, Rawatbhata's population is somewhere between 30,000 to 40,000. The growth is still continuing since work has started on reactors number 3 and 4, and four more reactors are in the planning stage. However, one point needs to be noted. Despite all the power generated at Rawatbhata, there is no other large industry anywhere in the vicinity. The major consumers of Rawatbhata power are the industries located at Kota, fifly kilometers to the north-east.

Why Rawatbhata was Selected?

The -Site Selection (Committee was constituted in 1961. It was asked to select a suitable site for a 200 MW nuclear power plant in the general area of Delhi, Punjab, Rajasthan and U.P, In all, ten sites were considered. Of these, two were found unsuitable and amongst the rest Rawatbhata was found the most suitable. The criteria (or selection included availability of cooling water, the capacity and the suitability of the electrical systern, considerations of geology and seismology. The scarcity of population was a prime consideration. Some weightage was also given to other factors such as access to the site, availability of land, agriculture, daily and fishery products.

N.B. Prasad Committee which in 1982 investigated the causer for the generally poor performance of the station, agreed

WHICH the choice of Ravarthata as the site for the first in a series **of similar nuclear plants around the country, but expressed some unhappiness. In its own words:**

"At the time of the selection of the site, there was very little experience with nuclear power generation anywhere in the world. Therefore the most* im-*portant guideline that determined the selection of the site was its remote location in an area of very low population density, whereby the consequences of a reactor accident would be minimised."

"While the site selected by the Site Selection Committee met all the criteria adopted for the selection of sites at that time, the re-

moteness of *the site adversity effected the operation and maintenance of the station. Tiu logistics were not satisfactory for quickly getting the required help nor were communication facilities satisfactory. It is difficult to quantify the loss of generation due to these factors but station staff have frequently referred to these difficulties."*

A Dismal Record

The history of operation of Rajasthan Atomic Power Station (RAPS) even when seen on purely technical grounds with no consideration for the human costs involved, is an extremely dismal one. Any objective analysis, based on criteria developed by the nuclear industry itself would also come to the same unflattering conclusion* Indian nucleocrats privately and in restricted circulation documents, admit to this sorry state. The following is an extract from the report of the Prasad Committee, which in 1982 went into the causes of this dismal performance.

"The analysis reveals that the operating record of RAPS-1 in the eight year period (from 1974 to 1982) has been somewhat chequered. There were bad years when the unit was totally shut down for long periods due to turbine blade failures or labour unrest. Intermittently, there were periods of slightly better operation, in 1974 and 1976, when the station operated at capacity factors of 40% and 46% respectively. There was a two-year period in 1979 and 1980 when the station operation was satisfactory and the stationi reached Capacity factors of 65% and 64% respectively. This has been again followed by poor performance in 1981 and a total shut-down during most of 1982.

The report of the committee (composed of bureaucrats from the Department of Atomic Energy and the Rajas than State Electricity Board) tries both to justify the choice of nuclear technology (in particular CANDU reactors), and simultaneously also find causes for the admittedly poor performance. It blamed the remoteness of the site, the poor communication facilities and the poor support from the grid with frequent and large fluctuations in the electricity supply, for the sorry state of affairs. In their own words:

"In Rajastan, all these years generation consisted of hydro and nuclear units only. Thus during drought periods there was no generation except nuclear available to the entire State of Rajastan and this has brought about tremendous pressures on the station management to keep the station going even under adverse conditions when they would have been better advised to shut down the station for plant maintenance. The result has been that RAPS did not get the operating environment foreseen in the design and could not be operated with the flexibility that was necessary for a prototype power station. Rqjastan in its turn, had to depend on what turned out to be a not so reliable power source for its needs, as forced outages at RAPS were for longer periods than normally associated with conventional power stations."

Lifetime generation of electricity from RAPS-1 has been less than 22 percent of rated capacity, while older Canadian plants of similar design have operated at 62 percent of capacity.

The Committee submitted its report in July 1982. It made many recommendations to improve the working of the plant. However, the crack in the South End Shield of the first unit has ended all hopes of better performance from this unit. In fact, since 1982, the unit was shut down for three whole years. (1983, '84 and '86) It has'since then, despite all efforts, produced less than 10 percent of its rated capacity. The performance of RAPS-2 has been in contrast far better. It has produced a little more than half its rated capacity. Contemporary units of Pickering Nuclear Generating Station in Canada have in contrast produced more than 90 percent of their rated capacity. Pickering is a much larger station with a capacity ten times that of RAPS.

Routine Emissions

(licial data regarding emissions of radioactive waste from the plant are hard to come by. There is a publication known as the "CANDU Owners Group Newsletter", published monthly, which is a compilation of official data for the use of Canadian electricity utility executives. The only information regarding the Indian and Pakistani CANDUs that is available in it concerns the amount of electricity produced during the month and the duration of time that the reactor was working. Data regarding the quantity of various kinds of waste products released into the air, water and or buried in the ground, or data on the radiation dose received by workers is not reported by the respective nuclear authorities in either country. This 'secrecy' is in contrast to the Canadians - the ones who sold us this technology in the first place - who, to their credit, do publish this kind of data.

Bits and pieces of such Indian data have been published and are available in obscure 'places. For example, data about releases of various radioactive gases to air through the stack, from RAPS-1 from 1973 to 1980 have been published as part of Mr K.K. Narayanan's M.Sc. thesis (title: "Population Exposure from Nuclear. Power Reactor Operation), submitted to the University of Bombay in 1983. Mr Narayanan was a member of the Health Physics Division of the Bhabha Atomic Research Centre. I am thankful to Shri R. Ashok Kumar of Bombay for the trouble he took in unearthing this data. Similarly, data regarding routine releases for the years from 1986 to 1990 haw been published in a paper en* titled "Environmental Impact of PHWR type Power Stations - Indian Experience by a team of Bhabha Atomic Research Centre scientists—IS. Bhat, M.A. Iyengar, R.P. Gurg, S. Krishna mony and K.C PiIlai which was part of the conference proceedings on Small and Medium Scale Reactors held in Delhi in 1991. I am thankful to Mr. R. Ramachandran of the New Delhi bureau of *"The Economic Times"* for bringing this paper to my notice.

But, there are serious questions regarding the reliability of the little data that is available in India. For example, the data tabulated in Table 1 regarding tritium releases for the years from 1980 to 1990 are taken from the paper by Bhat, et. al. The same paper carries the numbers given in column 5 regarding the air tritium in a two to ten km region found by measurements, carried out by the environmental survey laboratory. These authoro claim they placed monitoring equipment at various points all around the plant, which made measurements at various times in different seasons and the values given in column 5 of table 1 are the averages for the year. Howeve'r, the numbers in columns 4 and 5 do not match each other. Thus, we

Year	Argon-41	Iodine-131	Tritium	
	TBq	MBq	TBq	
1973	367.3	95.3	25.3	
1974	157.7	287	87.8	
1975	3,959	1,220	223.3	
1976	3,209	1,450	545.9	
1977	4,026	5,550	525.4	
1978	1,034	183	531.9	
1979	4,015	1,900	1,905	
1980	5,393	5,920	1,117	Annual Average Tritium Detected in a 2—10 km region Bq/m'
1986	4,106	230	661	2.6
1987	3,959	547	1,121	1.1
1988	5,767	10,019	1,028	1.3
1989	4,267	19,867	1,471	0.9
1990	10,640	1,398	2,566	1.0
Comparison With Pickering Station (4320 MW)				
1989	—	1290	1463	22
1990	—	410	908	17

Table 1: Routine Emissions **from RAPS**

have *an* anomalous. situation where column 4 says that almost four times as much tritium was released in the atmosphere from the stack in 1990 as was in 1986. On the other hand, column 5 says that the amount of tritium found in the air during 1990 was 2.6 times less than that found in 1986. The two factors taken together mean that there is a discrepancy of more than ten times in the amount of tritium released and that detected. Where has all the tritium gone? It seems at first sight to be too large an inconsistency to be accountable to factors like weather. One does not know which of these two sets of numbers, if either, to believe.

Even if we set questions regarding the veracity of the data aside, and accept the numbers as given at face value, they do show that the amount of radioactivity releases made by our reactors are far higher in than the Canadian CANDUs of similar design and age. The Pickering Nuclear Generating Station (PNGS) consists of eight reactors, each of 540 MW capacity. Four started during 1971 to 1973, that is a little before the startup of RAPP-1. The other four started from 1982 to 1985, a little after RAPP-2. Four reactors of 540 MW mean a total generating capacity of 2,160 MW. Thus, the electricity generation capacity at Pickering has on an average always remained more than ten times that of RAPS. The life time load factor (the ratio of the electricity actually produced to what the station would have produced if it had worked at full capacity all the time) has been 67% and 84% respectively. For comparison, RAPS-1 has a lifetime load factor of 22% and RAPS-2 of 54%. This means that the Pickering station has over the years produced well over 20 times more electricity than RAPS. The radioactive tritium releases in the air have during recent years been greater at RAPS than at Pickering. The numbers for 1989 and 1990 are presented in **table *2*. Thus, the unaccounted pollution burden** of **RAPS electricity is at least twenty times and sometimes** even **(as in 1990) fifty times higher than that of electricity from** Pickering. **Similar** comparisons with newer Canadian reactors would he even more adverse for RAPS.

But tritium emissions to the air is just one kind of radiological pollution. One might

The radiation burden on the workers at RAPS is at least eight times as much as that on the workers at Pickering though in 1990 Pickering produced 50 times more electricity than RAPS

ask

about other radioactive poisons like iodine-131. A comparison of RAPS with Pickering data show that the released amount in both cases is of the same order of magnitude. There is no mention in the Pickering data of Argon-41, whereas this radioactive gas is the largest component of the poisonous combination emitting from the RAPS stack. Although Argon-41 has a short half-life, a huge amount of it is being released, so it contributes very significantly to the radiation dose being received by the public in the vicinity of the plant.

Other parameter's can be used to determine the comparative dirtiness of plants, such as, the total radiation dose received by workers. The Canadian plants publish this data regularly. The numbers for RAPS were also published earlier. But since 1979 the authorities no longer publish such information even in nuclear industry journals abroad where, a lot more useful information about the Indian nuclear programme appears then is ever published in the 'Desi' press. **The format for reporting this dose makes separate columns for regular employees and contract labour. However; except for one year, (1976when the dose at RAPS-1** was **650 man-rem for regular employees and 150 man-rem for contract workers), the Indian authorities did not publish these** figures separately, but rather gave a combined figure. This figure hovered around 800 to 900 man-rem. In 1989 Dr. A.K. De, then chairman of the Atomic Energy Regulatory Board, made an announcement in the newspapers stating that the radiation dose to **workers at RAPS** and **MAPS** was **unacceptably** high at 1700 man-rem and he had recommended that the dose be brought down to 1000 man-rem. RAPS had been ordered closed **for** a **few** days because of this. Apart from this newspaper report there has been no other reference that I have come across which gives the total radiation dose to workers. It is not clear from the newspaper report whether 1700 man-rem is the dose due to both the reactors or if it is the dose due to each reactor. I suspect the latter, since prior to 1980 RAPS consisted of only RAPS-1 reactor and a dose of about 850 man-rem had not rung any alarm bells then. Another point which is not clear at all is whether this dose is the external dose received by workers or if it includes the internal dose absorbed by workers through inhalation of tritium and other radionuclides. The Canadian data makes a distinction between these two categories of radiation doses. However, even if we give the benefit of the doubt **to RAPS, and take** 850 **man-rem as the total (internal + external) dose at each reactor, this figure is eight times as high as the dose at Pickering. The Pickering dose is 111** man-**rem per reactor. As I mentioned before the Pickering reactors** have been **in** operation **the same amount of time as RAPS and produce twenty times more electricity.**

The Survey

Some of the material in this section has appeared before in "Anumukti"(See "Anumukti" Vol.3 No.6 and Vol.5 No.4). We are including it here in the interest of completeness. However, those who have seen this before can skip this section and go directly to results. A summary of the methods is presented for convenience.

We first went to Rawatbhata in April, 1990 at the invitation of the Parmanu Pradooshan Virodhi Sangharsh Samiti, a body formed by Sarpanches of ten villages around Rawatbhata. Despite the name, this was not an antinuclear group. The invitation to us was the proverbial clutching at straws when drowning. They had originally invited us a year earlier, but had later canceled the invitation. This cancellation had been done because the RAPS (Rajasthan Atomic Power Station) authorities had promised to look into their complaints on the condition that they would cancel their invitation to anti nuclear groups to come to Rawatbhata.

Their demands were the usual demands of people with respect to development projects: When would we taste the fruits of development? They wanted jobs, schools, roads, access to medical facilities, etc. One of the points they made was the fact that even after 17 years, the village on whose land the reactors had been built, (Tamlav) had yet to receive electricity connections. (See Sunils article *Rawatbhata: Development Brings Dissatisfaction* in *Anumukti* Vol.3 No.5, April, 1990)

Our report about the visit *(Chernobhata?)* **was** published **in *Anumukti* Vol.3 No.6, June, 1990. It received a good amount of national and some international publicity. Since then, other newspapers sent reporters and photographers to the area and they have published a number of reports. A British journalist, Christopher Mitchell made a** clandestine film, "The Price of Power", which was shown on Channel-4 in Britain on April 2, 1991. Excerpts from this film along with an interview with the Secretary of the Atomic Energy Regulatory Board (AERB), Dr K.S. Parthasarathy, were shown in the September 1991 edition of "Eyewitness"—a videomagazine brought out by *Hindustan Times TV.* The release of this video caused quite a comfnotion, with questions being asked in the Parliament and the subject remaining in the news for many consecutive days.

The Basic Difficulties

For more than a year we had been trying to persuade various independent organisations with expertise in the matter to conduct a door-to-door survey of the area. We felt diffident about doing the survey ourselves since we had very little expertise and virtually no resources to undertake this task. Unfortunately no organisation came forward to do this work on their own. Some organisations, who did show an interest, wanted to submit project proposals and get approval and grants from the government before proceeding However, government approval essentially means approval from Department of Atomic Energy (DAE). The DAE has been notorious for delaying grants and approval for such surveys. For example, they delayed for five years before giving grants to South Gujarat University for making a baseline health survey of the area around the Kakrapar nuclear power plant.

At the same time there were reoeated requeste from the people around Rawatbhata which promised all possible help in carrying out the survey. At the Bangalore meeting of antinuclear groups in April 1991, (See *"Anumukti"* Vol.4 No.6) there was strong support for the idea of conducting the survey. All these things together helped us decide to do the survey ourselves.

Not having done such a survey before we were ignorant of the difficulties involved and had no inkling of the different kinds of organisational skills required Now that the survey is done, we don't mind admitting that without expert help there is a good chance that we would have made a fine mess of things but fortune favoured us and we had a very lucky break is the form of a chance meeting with Dr Leela Visaria of the Gujarat Institute for Area Planning. She not only helped in the design of the survey schedules but also sent two absolutely invaluable investigators to help conduct the survey. Shri Vinayak Dave and Ms. IIa Mehta not only taught us a good deal but also took care to see that the survey was properly conducted and no household inadvertently left out We also received expert help from a team of eight doctors from various parts of the country who came and helped with the diagnosis of serious conditions.

The second great constraint was money. We cyed with the idea of applying for .a research grant, but gave that up due to considerations of the time and effort involved. Then we had a happy thought First of all reduce expenses to the absolute

burden so that no single entity gets too much of a load. It was decided that all investigators would volunteer not only their time and energy but also contribute their traveling expenses; boarding expenses would be the responsibility of our local hosts at Rampura and Rawatbhata; expenses such as publication of schedules, medicines and other equipment would be borne by the *"Anumukti"* group. We made an appeal for both volunteers and donations. The response was overwhelming and far beyond our expectations.

Methodology

Ideally, what one needs in a comparative survey are two populations which are similar in each and every respect, except as regards to the effects of the factor being studied. For a case like Rawatbhata, the best course would have been to have done a baseline survey before the plants were set up, and then to have repeated the same survey using the same methodology a few years later. This way, one could have compared the two, and if the setting up of the plant had resulted in any adverse health effects, these effects would have become apparent. Unfortunately, this course is not now open as the authorities did not do any baseline survey of the area before the plants began operation. In fact, even today new plants are being set up and the authorities have still not felt the need to do any kind of basic health survey, on the specious excuse that it is not a requirement for other hazardous industries.

The next best course is to do a comparative health survey of two similar populations. Obviously, it would not be sensible to compare the disease and deformity pattern of a population living in high rise apartments on Malabar Hill in Bombay with those of villagers around Rawatbhata, since the pattern would be different due to differences in lifestyle, genetic pool, environmental and stress factors, etc. The similarity of two populations is a difficult condition to meet, since there are so many factors which can vary between populations. The criteria used for selection are described in the following section.

Criteria for Selection

All the villages which were in the north-east direction of the plant within a ten kilometer radius were selected for the survey. We chose the north-east direction since during the monsoons, the wind direction is from the south-west towards the north-east. Logic dictates that if the routine air emissions of radioactivity from the plant were causing any adverse health effects in the surrounding area, then the effect would be most pronounced in the north-east direction, due to settling of radionuclides through rain. There were five villages in all (Tamlav, Deeppura, Malpura, Bakshpura and Jharjhani), which satisfied this criterion, with a total number of 551 houses and a population of 2860. Except for Tamlav, which lies closest to the plant, all the other villages are situated in a valley called the Kundal. Deeppura and Malpura lie just at the head of the valley, where it has narrowed down to almost a canyon, while Bakshpura and Jharjhani are further insiden the valley. There are other villages more distant from the plant or in other directions from the plant. But we did not include them in the survey for two reasons. Firstly, we had adopted the criteria of wind direction during monsoons and a distance of ten kilometers from the plant as the basis for selection and we did not want to deviate from this criterion. Secondly, to have included more villages would have meant substantially increasing the size of the population covered. That

would have made the survey
well beyond our capabilities.

For the sake of comparison, we chose the four villages of Khetpalia, Dhoodhlai, Anandipura and Chandrapura near Rampura in Mandsaur district of Madhya Pradesh. These four villages are more than fifty kilometers distant in the south by south-west direction. The total number of households were 472 and the population was 2544. The choice of the comparison distant villages was dictated by the fact that they were located in a very similar geographical setting — near another reservoir on the Chambal and near a small town. There was no other large industry in the neighbourhood of these 'distant' villages and the pattern of motorised vehicular transport was also very similar. Obviously, we could not have chosen the control villages much closer to RAPS, since then one would not be able to discount the effect of the plant, but neither could we choose villages much further away since then the geographical and socio-economic pattern would have been much different in the two areas.

The data that was collected provides information not only about people's health but also data like where they were born, educational status, employment, births and deaths within the last two years, pregnancy histories of all women of child-bearing age, land holdings, fertilizer and pesticide use, animal holdings, nutritional status, etc. Thus, we wanted not only to compare the health of the people in the near vicinity and those farther away, but also try to see what positive difference this giant nuclear enterprise had made to the economic status and prospects of its neighbours. We also wanted to confirm if the two populations were indeed comparable as hypothesized.

The Volunteers

Volunteers came from different parte of the country, but they all shared one quality—unbounded vigour and enthusiasm for work. It was indeed a revelation to see this kind of dedication. There was one group of 18 college students from Delhi, some of whom were post graduate students. The other large group' was students from Rampura college. There were two volunteers from Hoshangabad, and a group of eight doctors— two from Delhi, one from Gwalior and the rest from different parts of Gujarat who came for the last few days and helped by diagnosing the different ailments of the patients. Besides these volunteers, who did the actual work of data collection, there were many other local youths who helped by looking after us, bringing us food, interpreting and in various other ways.

The Nitty Gritty

Each and every household in the selected villages had to be identified first. To do this every house was numbered. Since we wanted the numbering to last for sometime in case a revisit was needed later, a small metal numbered disc was nailed to the front door of every house. Next, a volunteer wrote down the name of the head of the household and the total number of family members. A third person would at the same time draw a map of the village and place the house in the context of the map. All this had to be accomplished before any survey questions could be asked. Sometimes even this seemingly straightforward task could present unexpected difficulties. In Deeppura one day, all of un were astonished to see a group of people emerging from what looked like a field of tall corn. further enquiry revealed that We had completely missed four,'houses since they did not ha\e any visible entrance, being surrounded by
fields on all sides*

The numbering had to be logically consistent and the logic had to be apparent to someone who had not participated in the numbering process. Remark ably, this was accomplished so successfully that later on some villagers approached us with a request for a copy of our list, because they said the village pa richayat numbering was inaccurate and inadequate and they would prefer to adopt our more systematic approach

For the filling of survey schedules, a team consisting of a male and female volunteer each was assigned houses according to the map. Quite often there would be nobody at home and repeated visits had to be made. We had to reach the village almost at dawn since by 7:30 a.m. most folk would leave for work. Thus, the most productive times were early mornings and late evenings. Women in the family were the more crucial contact since only they could give us details of pregnancy history. Since women are the most overworked group, having to work both in the field and at home answering our persistent and seemingly never-ending questions was an additional imposition. But they cooperated and answered all the questions with exemplary forbearance. Sometimes, especially initially, there were communication problems due to the local Mewari dialect, but luckily most local youth did follow and speak Hindi and after a few days the volunteers had picked up enough to get by.

A Typical Day

day would begin usually around 4:30 in the morning, as we had to get ready and catch a bus or hitchhike on trucks to reach the villages early enough. The house numbering, listing and map making team would start on a new village while the scheduling team would fill schedule* in previously numberd and listed area. Sometimes villagers mistook us for people who would provide them with land deeds. In these cases, the false hopes had to be removed. There were times when people refused to answer any questions. In such cases one had to explain to them what the survey was about and persuade them. At times this could be a severe test of persuasive skills. Rut finally, there wasn't a single instance where a family did not consent to answer questions.

An air of uncertainty hung regarding meals, though our hosts in Rawatbhata went to extraordinary efforts to provide us food on time. I don't think anybody ever went hungry, but lunch wasnt something you could count on.

A lot of time was spent walking long distances during repeated visits to a house whose residents had gone out for work. Vinayak had the most work, since he had to keep the whole thing coordinated, distribute new house numbers to those who were unable to locate people in their assigned houses and then keep track that no house was left out and that there was minimum duplication.

By the time we returned to Rawatbhata in the evenings, hitching a ride back on trucks, it was around 9:00 p.m., and all of us were dead tired. A bath and dinner and most of all sleep was a welcome prospect However, before one could go to bed, one had to complete anything left unfinished in the schedules and also meat together to discuss the problems encountered during the day and decide on the next day's assignments. We rarely managed to get to bed before midnight.

Initially there was some cub ture shock, since city-volunteers had previously little experience of the extrte

poverty and the lack of sanitation in the villages. But the warmth with which the villagers welcomed us soon won us over and we decided to stay in the villages to avoid transportation hassles. We were treated so well that we felt like baratees' and ate some of the tastiest meals we had ever eaten.

Our best memories of the survey are connected with the truck rides back to Rawatbhata in which there was a lot of singing and some incredible feats of balancing on a fast moving truck without any kind of hand-holds. It was this spirit of bonhomie and unfailing good cheer that has established strong feelings of comradery between all of us.

The days spent at the survey counting diseases and watching stark poverty face to face and contrasting this scene with the monster development project nearby was the best possible education for the volunteers on the 'benefits' of nuclear energy. Any 'free' time was spent discussing all aspects of nuclear energy production and distribution. It was without doubt the best nuclear energy awareness camp that I have ever attended.

A Special Problem

Despite earlier fears to the contrary, there was no direct attempt by the authorities at stopping the survey. However, there were rumours and scares aplenty. Informers were a constant bother. Probably the reason there was no direct attempt at stopping the survey was the fortunately bad relationship between the RAPS bosses (their overbearing attitude hasn't made them loved) and the local administration. However, this is just speculation on our part. The RAPS authorities did succeed in forcing the local administration to take some 'action'. This action consisted in putting pressures on our local hosts, who were repeatedly harassed.

The Last Days

After completing the work at Rawatbhata we went to work at Rampura. The work here was just as busy as Rawatbhata. but it was easier and better organised. Our local hosts had arranged for a vehicle, so getting to and fro from the field area was no longer such a hassle.

The team of Doctors from various parts of the country came near the end of the process of data collection. We wanted them to check all the serious cases which had been identified in the survey and confirm the diagnosis. The doctors not only went to every house diagnosing, they also had to distribute medicines and to listen to all kinds of complaints. The data collection process had lasted from 4th of September 1991 to 22nd of September 1991.

Data collection was just the beginning. Next came analysis. The schedules had to be put in a computer ready format. We are very grateful to the team of computer operators at Gujarat Institute of Development Research for entering the data into the computer. The process of analysis and understanding required a lot of interaction with the computer and while the computers were at Ahemdabad, we were at Vedchhi. Frequent travels to and fro took a lot out of us. Fortunately, at this stage, our appeal for the donation of a computer was answered and we were able to start analysing the data in right earnest. Another lucky break was receiving a copy of a computer programme brought out jointly by Centre for Disease Control in Atlanta and the World Health Organisation called EPI-5 which was especially useful in doing the analysis.

Summary of the Methodology

Each and every house in the survey was visited by a team of two (one male and one female) investigators, who filled the precoded schedule consisting of questions pertaining to various demographic data; economic and educational status; disease and immunisation; land and animal holdings; irrigation; pesticide and fertiliser use; employment patterns; family size; births and deaths during the last two years; pregnancy outcome of all women in the reproductive age-group; etc. Twenty percent of the households were randomly selected for additional information on dietary intake. Authenticity of the data collection was checked by random revisits by another team consisting of a demographer and a physician.

It needs to be noted that both" the proximate as well as distant' villages are rural areas of Central India far away from metropolitan centres. Any visit by a large team of 'outsiders' in such an area is a socially significant event. Although the questions were put separately by the investigators to adult male and female respondents, usually the whole family was in attendance and very much a part of the process. The investigators were thus able to see and verify for themselves any obvious case of deformity or serious illness.

In all cases where the investigators reported a deformity or a serious long term illness whether congenital or acquired, this was later confirmed and classified through clinical examination by physicians. However, no radiological or laboratory examinations were carried out.

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Results

First of all, let us find out if the two selected populations are indeed comparable. To do this, we will look at a number of parameters like age and sex distribution of the population, caste composition, educational status, diet and nutritional status, land and animal holding patterns, employment, housing, general living conditions and social habit indicators like the age of marriage and child-bearing, etc.

Age, Sex and Caste

Data regarding age and sex distribution and caste composition are presented in Tables 2 and 3 respectively. What these tables show is a pattern of similarity in both areas. The age and sex distribution show no statistical differences at all. The caste composition on the other hand does show some variation in the two areas with scheduled tribes and upper castes being a little more in the proximate villages and the backward castes being more in the distant villages. Scheduled castes percentages in both the areas are equal. An examination of the subcastes (jatis) also reveals some likeness, with the same subcastes being represented in both the areas.

Education

The educational pattern (Table 4) too shows singular uniformity. More than 70 % of the people in both areas are illiterate. The distant villages have a slightly greater proportion of people who have studied until class VII at school. In the proximate villages those who do study seem to study a little longer. It needs to be emphasised that the numbers do not show any statistically significant variation in the two areas. The sex wise differentiation of this data does not throw up any kind of variation in the pattern of the two areas.

Age Group	Proximate Villages		Distant Vlllages	
	Males	Females	Males	Females
0 — l year	63(2%)	57(2%)	43 (2%)	55(2%)
1 — 4 years	136(5%)	134 (5%)	126(5%)	122(5%)
5 —14 years	393(14%)	370(13%)	356(14%)	359(14%)
15 —24 years	284 (10%)	283 (10%)	216(8%)	222 (9%)
25 —34 years	220 (8%)	196(7%)	176(7%)	180(7%)
35 — 44 years	141 (5%)	122 (4%)	140(6%)	108 (4%)
45 — 54 years	104 (4%)	100 (3%)	79(3%)	89 (3%)
Over 55 years	150 (5%)	107 (4%)	145(6%)	128(5%)
Total	1491 (52%)	1369(48%)	1281 (50%)	1263 (50%)

The percentages i in parenthesis to the whole numb subsequent tar. been rounded off ables have

Caste Group	Proximate Villages		Distant Villages	
	Males	Females	MALES	Females
Scheduled Tribes	162 (6%)	131 (5%)	151(6%)	165(6%)
Scheduled Castes	421(15%)	371(13%)	268(11%)	263(10%)
Upper Castes	202(7%)	188(7%)	103(4%)	87(3%)
Backward Castes	703(25%)	674(24%)	755(30%)	745(29%)
Muslims	3(0%)		4(0%)	3(0%)
Total	1491 (52%)	1369 (48%)	1281 (60%)	1263 (50%)

Table 3: Caste Composition

Qualifications	Proximate Villages		Distant Vlllages	
	Males	Females	MALES	Females
Illiterate	877(31%)	1214(42%)	681 (27%)	1118 (44%)
Up to Class 6	368(13%)	118(4%)	412 (16%)	128 (5%)
Up to Class 10	216(8%)	34(1%)	163 (7%)	17(1%)
Up to Class 12	24 (1%)	3	16 (1%)	0 (0%)
More than Class 12	6(0%)	0(0%)	4(0%)	0(0%)

Table 4: Comparative Educational Status

Cotegory	Proximate Villages	Distant Villages
1 Energy	2474 ± 991 cal	2405 ± 784 cal
Protien	80 ± 30 gins.	79± 27gma
Carbohydrates	448 ± 159 gms	457 ±156 gms
Fate	32 ± 25 gms	27 ± 16 gms
Calcium	549±346 mg	522 ± 275 mg
Iron	38 ± 35 mg	39 ± 37 mg
Vitamin A	778 ± 698 mg	257± 1904 mg
Vitamin C	13 ± 20 mg	24 ± 34 mg

Table 5: Per Capita Dietary Intake

	Proximate Villages	Distant Villages
Family Size	5.19 ±2.66	5.39 ±2.67
Women Head of House	5.4%	5.5%
Av. Pregnancies	5.30±2.09 _____	5.15 ±2.16
Woman's Age at:	·	
Effective Marriage (Gauna)	15.1 * 2.0 years	15.4 ± 2.5 years
Birth of First Child	18.4 ± 3.1 years	19.3 ± 3.2 years
Live-Birth	23.7 ± 5.7 years	24.0 ± 5.5 years
1 Abortion	23.1 ± 5.9 years	21.5 ± 5.2 years
Still-Birth	22.8 ± 7.0 years	22.0 ± 6.7 years
Birth of Deformed Child	25.2 ± 5.8 years	23.8 ± 4.9 years
Av. Number of Children Born to Women Aged 45—49 Years	6.3	7.1

Table 6: Maternity Indeces

Nutrition

Another point of striking similarity between the two areas is the diet. (Table 5) The questions regarding diet were asked to a randomly selected 20 percent sample in both the areas. The question asked related to the food intake of the previous day. Different families had naturally eaten a variety of foods and also the amounts eaten were widely different. There were families who had fasted that particular day and others who had feasted. A pattern of per capita (considering an adult male as a unit and multiplying other members of the family by appropriate factors), nutritional intake for each area was calculated using the standard nutritional tables and procedures. The results show that the average nutritional status of x>th the areas is identical We have calculated not only the average caloric intake in each area, but also the intake of proteins, fats, carbohydrates, vitamins A and C as well as minerals such as calcium and iron. The averages in both places of *the* caloric intake show that the *met* is the same as the average dian diet. There was a near total absence of green leafy vegetables and fresh fruit in the in diet of the proximate villages. This might be a seasonal phenomenon. Absence of fruits and green vegetables in proximate villages' diet accounts for the differences observed in the vitamin A and C intake. The variation in the intake within each area is far larger than the differences between the two. The differences in the vitamin intake in the two areas cannot account for the wide variation seen in the health pattern (seo below).

Differences observed in the health pattern cannot be due to deficiencies in diet. The mean caloric intake is the same as that of the average Indian diet.

Maternity Indices

Table 6 tabulates various indices, related to women, like average number of pregnacies., average family size, age of the women at marriage and at the birth of the first child. The average age of women at the time of miscarriages, birth of a still born child and of a deformed child are also tabulated. These numbers are uniform in both areas. The numbers are important since they show that the differences observed in untoward pregnancy outcome, especially in the case of congenital deformities, cannot be attributed to factors like differences in the age of child bearing.

Living Conditions

The housing conditions in both the areas are quite comparable. Over 80 percent of the houses are mud construction Teutons' houses and only around ten percent of the houses are brick or stone 'pukka' houses, with a permanent roof. The other ten percent in both areas come somewhere in between, with some parts built in stone and the rest in mud. The size of the houses (number of rooms) is also alike in both the areas.

However, there is a significant difference in the number of houses having electricity. Surprisingly, while only 20 percent of the houses near this 'electricity producing' atomic power plant have electricity, the percentage in the far- off villages is 52 percent.

Three fourths of the people (74.1* in proximate villages and 76.4% in distant villages) are livestock owners, mainly sheep, goats, cows, bullocks and buffaloes. In both areas the number of large cattle owners (more than 15 animals) are similar (15*). While cows are prefered in the proximate areas, buffaloes are favoured in the distant region.

Another parameter we looked at was the amount of time spent in getting drinking water and the type of water supply arrangement (Table 7). More households (66.5 %) in nearby villages get their water within a five-minute walking distance than those in far-off villages (52 *). But, at the same time, more also need to walk an hour (10.9 *) nearby than faroff (7%). Water supply arrangements (Table 7) show that while ten percent of the people get tap water, nearly two percent of house holds (all in Tamlav) still go to the pond for their drinking water (see discussion section below).

	Proximate) Villages	Distant Villages
Housing Condition		
One room	61.2*	56.1%
2 to 4 rooms	37*	41.6*
4 rooms or more	1.6*	2.3*
'Kutcha' Houses	85.3*	82.5%
Electrified Houses	19.93*	52.02*
Water Supply		
Well	59*	71.3%
Hand pump	28.6*	28.2%
Water Tap	9.8*	—
Pond	2*	—
5 Minutes Walk	66.5*	52%
15 Minutes Walk	21.4*	40.8*
1 Hours Walk	10.9*	7*

	Proximate) Villages	Distant Villages
Housing Condition		
One room	61.2%	56.1%
2 to 4 rooms	37%	41.6*
4 rooms or more	1.6%	2.3*
'Kutcha' Housee	85.3%	82.5%
Electrified Houses	19.93%	52.02*
Wote* Supply		
Weil	59*	71.3%
Hand pump	28.6*	28.2%
Water Tap	9.8*	—
Pond	2*	—
5 Minutes Walk	66.5*	52%
15 Minutes Walk	21.4*	40.8*
Hours Walk	10.9*	7*

Table 7: Housing Conditions and Water Supply

ing sets in the remote area (57% irrigated land) than around Rawatbhata (39.3% irrigated). Households in the far away villages use more fertiliser and pesticides than those near Rawatbhata. There are significantly larger number of pump set owners in distant villages (139, 29.4%) than in proximate villages (38, 6.9%). This fact too highlights the anomaly that those living near the electricity producing plant are deprived of the benefits of power.

Work Category	Proximate Village*	Distant Villages
Employer	0.5*	0.2%
Self Employed	27*	19%
Assistant	8*	12%

Labourer	13*
Salaried Employee	2*
Unemployed	1*
Housewives	9*
Students	9*
Children	27%
Retired	1.5%
Disabled	0.2%

Table 8: Employment Status

Land Holding and Agricultural Practices

The land own

ership pattern shows that more households in the proximate area are land holders. While 75 percent of households nearby own some land, the number of such households in the far villages is only 66 percent. There are far mora landleas people in distant villages than in near villages. However, if we look at the amount of irrigated land the figures are reversed. There is a much higher degree of irrigation and availability of electrified pump-

Employment

The employment pattern (Table: 8) mirrors the land holding. More people (34.8% vs 31.5%) are self employed (mainly family farms) in the near villages as compared to the far villages where the number of labourers and assistants is a little larger (15% to 18.4%). Amongst the other categories we find that salaried employees and those employing others are more in near villages than in the remote onus. The absolute numbers are small in these cases. On the other hand, there are more retired people in the distant villages. Except for these small differences, there are no differences at all between the two areas with the proportionate numbers of children and students, housewives, unemployed and disabled being exactly the same.

The major difference is the proximity of RAPS. More detailed breakup of the category of labourers and salaried employees reveals that while over 99.5% of those in the distant area are employed in the village itself; in the proximate area 44% find work in the Anushakti complex. By Anushakti complex, we mean the campus consisting of operating nuclear reactors of RAPS—1 and 2, the Heavy Water Plant, and the new construction sites for RAPS—3 and 4.

Let us consider salaried employees first. Out of a total of 51 such persons, only eight have got work in RAPS and one in Heavy Water Plant. Of these nine, (all males, by the way), live were outside migrants who were not born in the area. The whole Anushakti complex—this giant development project with an investment of hundreds of crores in the past, and thousands of crores of new investment in RAPS-3 and RAPS-4—was resulted in regular salaried Jobs for just four local people in these five villages.

RAPS has provided far more work for 'casual' workers. These casual workers are not casual in the sense of being intermittent, but rather are regular workers who are employed through the agency of labour contractors. The number of these labourers varies seasonally depending upon the work available at RAPS, but during the survey half the labour force (190 out of 381) was working at Anushakti We were told that due to a slowdown in construction of Units three and four during the time of the survey, this percentage was on the low side. The need for contract workers is greatest when the construction work is proceeding normally and there is shutdown in the operating reactors (Units one and two). Contract workers are used a lot during cleaning.

Over 40% of the labourers are people who have not been born in the area. In contrast to the case of regular employees, women form a substantial proportion (over 40 percent) of the labourers. 49% of the women labourers were born outside the area and have come after marriage. However, 36% of the male contract workers are migrants from outside.

The most shocking aspect of work at RAPS is the recruitment of child labour. We found that 8% of all the contract labourers from the survey area were children under the age of 15. Boys during puberty are especially vulnerable to radioactive pollution since that is the time when their testes are maturing and any damage to the embryonic cells can have lifelong consequences in terms of untoward pregnancy outcomes. Almost all the women who work at RAPS complex are in their reproductive period. Developing fetuses especially during early pregnancy, are most vulnerable to radioactive hazards.

A Good Match

On the basis of the information given above we can confirm that both the areas are equivalent and therefore comparable. There are some significant differences, but these are not differences of lifestyle, rather are differences mainly associated with development (see section on discussion). The similarities between the two areas are striking and are in great contrast to the large differences that we observe in the disease, deformity and mortality patterns (see below).

The practice of child contract labour in nuclear plants is reprehensible. Pregnant and lactating mothers and young children should not be allowed to work within the premises. The poor are driven by poverty to seek a livelihood even in the most dangerous work. But should the authorities not bemore concerned regarding the long term consequences

Health Indicators

The first and the most conepicuous difference that one finds in the health of the two areas is that considerably more people complain of ill health in proxirhate villages and they complain about a larger number of ills. Despite this, most interestingly, a majority of the population of the proximate area said that they had no health problems at all. While 25 percent of the population in the remote villages had at least one health related complaint, the percentage of people around RAPS was 44.6%. If we look at households as a unit, we find that while there were 160 households out of 472 in far villages (Rampura area) who did not report any sickness, and 25 families all of whose members reported at least one sickness, the numbers in the case of near villages were 91 and 80 respectively (out of 551). This tendency towards greater sickness in the proximate villages becomes more apparent as we look at complainants with larger number of problems. For example, there are 68 households with at least one person complaining of four separate problems in near villages, whereas the number for the far villages is nine.

Another interesting observetion is that there are some types of complaints where no statistical differences in number of affected persons between the two areas were found..These jnclude short duration fevers, breathing difficulties and conjunctivites (see Table 9); there were no differences observed in the patients with hospital confirmed diagnoses of heart disease and diabetes. The number of such patients with confirmed hospital records (in both the areas) were very few.

In contrast, there are other types of complaints where we find huge differences between the number of affected persons. The incidence of chronic prob-

Table 9: Disease Prevalence

Typo of Slckness	Proximate Villages	Distont Villages
Short Duration Fover Affected Persons Average Age	137 (4.8%) 24 * 19 years	117 (4.6%) 26 ± 19 years
Breathing Difficutties Affected Persons Average Age	71 (2.5%) 46 years	52 (2.0%) 48 years
Persistant Cough Affected Persons Average Age	103 (3.6%) 31 * 19 years	60 (2.4%) 42 ± 22 years
Long Duration Favors Affected Persons Average Age	120 (4.2%) 26 ± 17.6 years	41 (1.6%) 30 * 17.5 years
Body Ache Affected Persons Average Age	126(4.4%) 34 ± 15 years	23 (0.9%) 33 ± 16 years
Pain in Joints Affected Persons Average Age	116(4.1%) 43 ± 15 years	5G (2.2%) 45 * 16 years
Digestive Problems Affected Persons Average Age	360(12.9%) 29 ± 18 years	151 (6.0%) 33 ± 19 years
Weakness & Debillty Affected Persons Average Age	147(5.1%) 36 ± 17 years	96 (3.8%) 46 ± 18 years
Skin Diseases Affected Persons' Average Age	208 (7.3%) 21 ± 19 years	76 (2.9%) 21 ± 20 years
Solid Tumours Affected Persons Average Age	30(1.1%) 41 ± 21 years	6 (0.2%) 60 ± 18 years
Eye Problems Affected Persons Average Age	51 (1.8%) 39 ± 21 years	20 (0.8%) 42 ± 13 years
Conjunctiviest Affected Persons Average Age	16 (0.6%) 15 ± *17* years	12 (0.6%) 12 a 12 years
Cataract Affected Persons Average Age	21 (0.7%) 58 ± 15 years	8 (0.3%) 68 ± 7 years
Acquired Defromities Affected Persons Average Age	31 (1.1%) 41 ± 15 years	17(0.7%) 48 a 18 years
Polio Affected Persons Average Age	24 (0.8%) 21 a 18 years	17 (0.7%) 21 ± 15 years

lema like long duration fevers, long lasting and frequently recurring skin problems of • various types, eye problems, continual digestive tract problems, pain in joints and body ache, a persistent feeling of lethargy and general debility, are all two to three times higher in the proximate villages. The probability that such differences could be a coincidence (in other words without a 'causative' agent) in most cases is less than one in a thousand.

Detailed specific analysis of these general complaints reveals more. When general eye problems are examined, we find that while there is no difference at all in cases of conjunctivites, the incidence of cataract is almost double. Similarly, for skin problems, we found larger numbers of problems such as hyperkeratosis and hypopigmentation. A great surprise was finding four men with large keloids all over their body, none of whom had any history of injury and three of whom had worked at RAPS in the past. The largest differences were to be seen in solid tumours of various kinds. While there were 30 cases of these tumours, one of them as large as a football on the chest of a women and several were the size of tennis balls. There were only five such cases in the distant villages and none so large.

A detailed diagnoses by doctors of each complaint of each individual was a task beyond our capability. Wherever proper diagnoses was done, it provides very eloquent testimony. Nine cases of pterygium—an eye problem Associated with the growth of cornea implicating radiation (usually found in workers using welding, equipment)—were observed among children by the doctors. Since this was a condition of which (in the early stages) even the sufferers were unaware of, these would not be reported to the investigators as a complaint. While we can make no statements of statistical significance regarding pterygium, since our methodology was not refined enough to do so, this does make a case for a thorough examination by eye specialists of the incidence of this disease in the area around Rawatbhata.

Another aspect of this disease pattern is the greater susceptibility of the young in the near villages to various health problems. This is seen in a number of complaints across the board (see the average age of complainant in Table 9). We find that there are some symptoms for which there is no difference in the average age between the two areas, and others where the difference in the average ages between the two areas is as much as 12 years. Invariably we find the younger invalids to be living near the nuclear power plant. Since the variation in the ages is very great, we are not in a position to make statistically significant statements regarding age, but it is a remarkable trend.

We were not equipped to detect cancers. But we found four cancer patients in the proximate area, who had been diagnosed as such by hospitals in Kota and Udaipur and who were taking treatment. Amongst the 75 persons who had died during the last two years in this area we found that six who had done so from various kinds of cancers and whose relatives had papers of hospital admissions and treatment. In contrast we found just one person in the remote area to have papers regarding cancer treatment.

A note on Statistical Significance

There are well established statistical procedures to compare some quantity in two different populations, like for example congenital deformities in far and near villages. Essentially, one is looking for the answer to the following question: what is the probability that the difference in the observations in both areas is purely due to chance? If the probability (p) is less than 5 per cent then statisticians accept that the difference in the two observations is not due to chance but is the result of some 'cause'. Thus when we say that p is less than 0.001 for the prevalence of congenital deformities in the populations of the far and near villages, what one is saying is that the chance that this difference could be purely a coincidence is less than one in a thousand.

"Increasing radiation exposure accelerates the aging process. The wear and tear caused by radiation results in the gradual accumulation of mistakes in the body's homeostatic mechanisms."

Dr ROSALIVE Bertell
No Immediate Danger: Prognosis for a Radioactive Earth

April / May 1993

Deformity Pattern

A distinction needs to be, made between congenital deformities and deformities acquired later either through illness or accident. All the deformities, without exception, that were observed in both the areas were examined and classified by doctors.

There is no statistical difference in the number of acquired deformities in both areas. These deformities (see table 9) are due to various causes, like accidents (9 near, 7 far); blindness due to smallpox (4 : 2); Burger's disease (4 . 3); paralysis due to neuromuscular disease (3 : 1), and so on.

Deformities due to polio bear closer scrutiny. The total numbers are 24 in the proximate villages and 17 in the distant villages. These numbers in the total population of each area are not significantly different. The mean age of the polio victims in both the areas is similar. However, if we look at the age wise distribution, we find that there are larger number of young children in the proximate villages, who are polio victims.

Table 10 tabulates the prevalence of congenital malformations in the population of the two areas.'The prevalence is significantly higher ($p<0.0009$) for proximate villages over distant villages for the total population taken as a whole. However, if one compares deformities only in 'children, the differences in the two areas become more pronounced While the relative risk for deformities is 2.8 ($p<0.0009$) for the total population, it increases to 3.45 ($p<0 0005$) for people leas than eighteen years of age (born after RAPS-1 started), and to 5.08 ($p<0.0002$) for children less than eleven, when the second unit commenced. It is also significantly higher amongst children in the proximate villages when compared to the adult population, even when account is made of the higher early mortality due to life-threatening congenital malformations. When we compare the number of deformities between children and adults of the proximate area itself, we find the p to be less than one in a million (0.0000001). liters Is no significant difference in congenital malformations amongst adults of the two areas or amongst adults and children of the distant villages.

Deformities of the musculoskeletal system (such as amputed hands and toes, club foot, extra fingers and webbed feet and other limb deformities) were predominant (16 in proximate villages as compared to 5 in the distant area). Other major types observed were deformities of sense organs, deaf mutism, mental retardation, deformities of ganito-urinary system, central nervous system and the digestive system. No minor deformities (skin tags, heamangiomas, birthmarks, ear tags, tongue-ties, etc.) were recorded in either area. Two families (one each in both areas) have all siblings with serious congenital squints in both eyes. But for this singular instance, all the other deformities in the proximate area are not running in families. Although there are two instances of two deformities in the same household, they are both different deformities, and the parents in all cases do not have the deformity. In all the ~~cases~~ of musculo-sksletel deformities in children in the proximate villages, the deformities are unilateral (one-sided). The significance of this is due to the fact that inherited (familial)

Deformities	Proximate Villages	Distant Villages
total Population	50(44)	14(14)
Above 16 years	5(5)	**4(4)**
below **18 years**	**45(39)**	**10 (10)**
below **11 years**	38 (33)	**6(6)**
Deformity Pattern Soon In the Last Two years)		
LIVE B**ORN**		
With Deformity	16	**3**
Without Deformity	236	**194**
STILLSORN		
With Deformity	4	**0**
Without **Deformity**	2	**0**

The figures in parenthesis are the number of people. There are five cases of multiple deformities all in proximate villages, four with two deformities each and one with three. The category 'below 18 years" includes the category "below 11 years". There is an almost three to one preponderance of males over females with deformites in both areas. 31 and 20 children born during the last two years respectively in proximate and distant villages have died (see Table 12)

Table 10: Deformity Pattern

deformities are usually bilat-
eral.

All the five cases of multiple deformities are children under the age of 18 in proximate villages. Four of them have two deformities each, while one has congenital deafness, a polycystic kidney and hydrocephalus together. ,

Pregnancy Outcomes

As noted earlier in Table 6, the age of marriage, the age at which the new bride comes to live at her husband's house ('Gauna'), the age of the mother, at the birth of the first child, average number of pregnancies, the age of childbearing mothers averaged over all pregnancies etc. are all very similar in both areas. While the number of abortions, still-births, and congenital abnormalities amongst dead and surviving children (table 11) are all much higher in proximate villages, the average age of mothers at the time of these untoward pregnancy outcomes is similar (see Table 6). In our study we have considered abortion as termination of pregnancy after eight weeks of conception. That is after two consecutive periods have been missed. Congenital deformities amongst dead children were counted only in cases where the mothers were able to describe in detail the form of the deformity in the dead child. Most of these deformed children had either been stillborn or had died within a few hours of birth. They seem to be mainly cases of neural tube defects.

In the survey there were separate questions regarding births during the last two years. Since our survey depended on people's recall of events, the last two year's numbers are likely to be more reliable as compared to those of earlier years. During the two years previous to the survey, there were 20 babies born with some kind of deform-

Time Period _____	Proximate Villages	Distant Villages
Abortions		
Within Last Two Years	27 (9.4)	5 (2.5)
Between 2 and 10 Years	35 (4.6)	15 (2.1)
Between 10 and 20 Years	15 (3.0)	9(2.3)
More than 20 Years	3 (2.5)	0
Still-Births		
Within Last Two Years	6(2.1)	0
Between 2 and 10 Years	20 (2.6)	6 (0.8)
Between 10 and 20 Years	13 (2.6)	5 (1.3)
More than 20 Years	5 (4.2)	1 (14)
Bom Alive But Now Dead		
Within Last Two Years	31 (10.8)	20 (9.9)
Between 2 and 10 Years	111(14.7)	118(16.6)
Between 10 and 20 Years	83 (16.8)	92 (23.2)
More than 20 Years	30 (25.4)	18 (24.3)
Living		
Within Last Two Years	221 (77.3)	177 (87.6)
Between 2 and 10 Years	589 (77.9)	572 (80.5)
Between 10 and 20 Years	383 (77.5)	290 (73.2)
More than 20 Years	80 (67.8)	55 (74.3)

The number in parenthesis are percentages of the particular outcome in relation to other outcomes within the same time frame. For example a, 9.4 percent of the pregnancies in proximate villages during the last two resulted in abortions, 2.1 percent in still births and the rest resulted in live born children. Of these, some, representing 10.8 percent of the deliveries have already expired while the other 77.3 percent still survive.

Table 11: Pregnancy

ity in the proximate area. In contrast, there were only three such babies in the distant area. Of the 20, four were still born while 16 were liveborn but nine of them had died by the time of the survey and there were seven children who were still alive.

Table 13 lists 10 deaths due to congenital abnormalities but' that includes one boy who had been born with deformity more than two years ago, but who had died within the last two years. In the distant villages, of the three children born

Time Perlod	Proximate Villag		
Abortions			
Within Last Two Years	27 (9.4)		
Between 2 and 10 Years	35 (4.6)		
Between 10 and 20 Years	15 (3.0)		
More than 20 Years	3 (2.5)		
Still-Births			
Within Last Two Years	6(2.1)		
Between 2 and 10 Years	20 (2.6)		
Between 10 and 20 Years	13 (2.6)		
More than 20 Years	5 (4.2)		
Bom Alive But Now Dead			
Within Last Two Years	31 (10.8)		
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Between 10 and 20 Years	383 (77.5)		290 (73.2)
More than 20 Years	80 (67.8)		55 (74.3)

The number in parenthesis are percentages of the particular outcome in relation to other outcomes within the same time frame. For example a, 9.4 percent of the pregnancies in proximate villages during the last two resulted in abortions, 2.1 percent in still births and the rest resulted in live born children. Of these, some, representing 10.8 percent of the deliveries have already expired while the other 77.3 percent still survive.

deformity during the last two years, two were alive while one had died. We made a separate calculation for the mean age of mothers of deformed children born during the last two years. The average age of such mothers in proximate area was 27.6 years and it was 22.7 years in the distant villages. Four such mothers were more than 35 years of age (all less than 40) while pone was younger than 19. Of the three mothers in the distant villages, one was 16, another 22 and the third was 30. It is known that the chances of bearing a deformed baby are higher if the mother is either very young or very old. These numbers indicate that this cannot be an explanation for the observed differences in deformities amongst children.

Abortions and still births were also seen to be far higher in proximate villages during the last two years. It might be argued that these numbers are 'unverifiable'. But there is strong circumstancial evidence which reinforces this finding. There are significantly larger number of issue-less couples (couples who have been married for at least four years, have been trying to have children and have either never conceived (23 vs 13) or have not given birth to a live baby due to repeated abortions and stillbirths (13 vs 2) in the proximate area.

Age specific fertility rates and age specific marital fertility rates were calculated for both the areas based on pregnancy histories of women of reproductive age. These numbers are in good agreement with those from census data for the area. Although we made all efforts to contact each and *every* eligible woman, we did miss a few (nearly 16 percent in both areas) sines they were not available, being away from the area during the time of the survey.

Crude Birth Rate	44.1 (34.3) 38.7 (38.7)
Gross Fertility Rate	193 179
Age Specific Fertility Rata Age Group Proximate Villages	Distant Villages
15 — 19 68(71)	50(88) 318 (262)
20 — 24 330(254)	359 (252) 171(177)
25 — 29 347 (267)	123(119) 26 (62)
30 — 34 262(212)	57(21)

1 The numbers in parenthesis are fertility rates for Chittorgarh
1
1 and Mandsaur districts in Rajasthan and Madhya Pradesh
1

1 The gross fertility rate has been calculated per thousand
1
1 women of reproductive age.
1

Table 12: Fertility Indicators

Untoward pregnancy outcomes are significantly greater near the nuclear power plant. The number of people complaining of sterility is greater. Abortions and still births are far larger. The number of babies who die within a few hours of birth is much larger. More congenitally deformed babies are born. These huge differences cannot be explained away by pointing to unsanitary living conditions. Neither can these differences be attributed to differences in the ages of child-bearing mothers, which are similar.

Mortality

It may be he shall take my hand
And lead me to his dark land
Close my eyes and quench my breath,
For I have a rendezvous with death.

76 persons died in the proximate area during the two years previous to the survey. The equivalent number in the case of the distant villages was 59. Since the population of the proximate area was 2860 as compared to 2544 in the distant Area, these numbers at first sight do not appear to be alarming. But the moment we do a break up of these numbers in terms of causes of death, and also in terms of age at death, these numbers tell a very different and a frightening tale. The difference in the average age of the deceased in the two areas is 11 years. People are dying younger in the proximate area.

Although these differences in the mean ages of people dying are dramatic, since the variation is very large, they are not statistically significant. To demonstrate statistical significance in mortality numbers would need a much larger sample size. But the numbers do demonstrate a trend, and it would not be difficult for any agency like the census bureau to conduct a larger survey and compare the results with those for other comparable parts of rural Rajas than and Madhya Pradesh.

Let us first consider neonatal mortality. That is those newborn babies who died within first four weeks of birth. There were 16 such babies in the proximate area and eight in the distant area. But we find a very high proportion (7 out of 16) of early neonatal deaths in the proximate villages to have taken place within one day of birth.

Cause s of Death in Children **(Aged <5 Years)**

Cause • of Death	**Proximate Villages**	**Distant Villages**
Fevers	3	7
Diarrhoea	6	**3**
Tetanus	1	**6**
Respiratory Infection	1	**3**
Measles	1	**0**
Polio	1	**1**
Congenital Defects	10	**1**
Small Baby	10	**1**
Unknown Causes	3	**1**

Causes of Death in Adults **(Aged** > Five Years)

Fever	11	**9**
Respiratory Problems	5	**6**
Diarrhoea	5	**6**
Old Age	8	**14**
Pain Abdomen	2	**1**
Paralysis	2	**2**
Accidents	1	**2**
Perinatal Deaths	2	**0**
Cancers	6	**2**
Unknown Causes	0	**3**

Table 13: Causes of Death

	Proximate Villages	**Distant Vlllages**
Stillbirths	6 (1.9)	**0 (1.5)**
One Day Deaths	7	**1**
Early Neonatal Deaths	13 (8.2)	**5 (8.5)**
Infant Mortality	**32 (28.2)**	**19** (22.6)

The numbers without parentheses are the actual observations. The number in parentheses are those expected on the basis of census data for Rajasthan and Madhya Pradesh.

Table 14: Deaths Amongst Infants During the Last Two Years

There was just one such case in the distant villages. If we exclude these one day deaths, then there is hardly any (half a day's difference) between the average ages at death, of the neonates.

An examination of the causes of death amongst children less than five (Table 13), shows that infections, fevers, tetanus, are the predominant causes in the distant area, but that is not the case in the proximate area, where, congenital deformities, small size of the baby and diarroea are more common.

We find a contrast in the causes of death in adults as well. The number of patients who succumbed to cancer is far too high in the proximate area. We have only counted those in this category, whose relatives were able to show us hospital papers which certified cancer.

Age Group	Proximate Villages	Distant Villages
0—4 years	47.4	36. 1
	5.5	3.5
15—24 years	3.5	0
25—34 years	2.4	4.2
35—44 years	8.5	2.0
45—54 years	7.3	3.0
More than 55 years	23.3	33.0

Table 15: Age Specific Death Rates

Another difference that we observed was that two cases of maternal mortality were observed in the proximate area. None was seen in the distant villages.

The numbers in parenthesis in Table 12 were calculated from the census data for Madhya Pradesh and Rajas than for 1987. Analysing the census data over the last two decades, we find a steady decline in all mortality indicators, including the stillbirth rate. Our observation of zero stillbirths during the last two years in the distant villages is within the range of statistical fluctuation. The observation of six stillbirths in proximate villages is significantly higher.

Limitations of the Survey

The survey does suffer from a number of limitations which should be kept in mind while evaluating the results. These limitations need to be overcome in any future research project.

As discussed in the methodology, we started with a hypothesis that the wind especially during the monsoons, was the main carrier of radioactive effluents from the plant to the surrounding population. The reason for favouring this hypothesis was that during the monsoon months the wind velocity is generally high and so is the precipitation. As a result, the "routine emissions'[9] from the plant are likely to get carried to the nearby villages over the hills and then get precipitated there. Once these radionuclides get deposited in the soil they are likely to get into the food chain and since a lot of the food produced in this area is also consumed locally these radionuclides would have an adverse effect on the health of the local residents. However, during the survey we found that there were many other equally likely pathways which could perform the task of transporting radioactive waste from the plant premises to the local population. One important alternative pathway for example is due to the fact that a lot of people in the nearby villages work as casual labourers in the plant premises and hence are getting directly exposed. Since the villages we have chosen near the plant all lie in a cluster in the north east direction, they do not constitute a representative random sample of all the people living in the ten kilometre vicinity of the plant. There have been a number of anecdotal reports regarding deformities and tumours and diagnosed cases of cancer amongst the people in these other villages as well as the township of Rawatbhata. In fact, we too have come across a number of such cases in villages other than the survey villages. Thus, though this survey does unambiguously indicate something drastically wrong in the area around north- east of Rawatbhata, a more complete study taking a statistically proper sample of all the population around the plant still needs to be done. In fact, the possibility of different pathways for radioactive pollution to reach the local population makes us suspect that what we have seen in the survey is just the tip of the iceberg and a more comprehensive survey would detect far larger number of sick and deformed people especially children who would need special care from the society at large.

A major flaw in our methodology was that the questions we asked the respondents regarding employment, were related to their present status of work. There were no questions regarding past employment. Thus, our survey is not able to distinguish between those who have never worked in the RAPS complex and those who have worked there in the past but were not working at the site at the time of the survey. Since casual employment is strongly dependent on a lot of factors including the seasonal need for agricultural labour, and the status of the plant operation, the actual number of people who do work at the plant can vary greatly from time to time. Thus our finding that over 26% of households have at least one member working in the plant complex, is just a 'reading[1] and not an annual average. There could be many more or less number of people who might have been going to do work in RAPS at different times. There were also no questions to distinguish between those whose work would take them inside the plant proper and regarding the kind of work they did there, and others whose work might not have involved going inside the plant but was confined to the premises of the plant This is an especially serious shortcoming since we are not able to say anything about the employment of parents of congenitally deformed children at the time the children were born.

We stated before that the Rawatbhata area is devoid of other industries and vehicular traffic so that there are no confounding factors. However, this statemeat needs to be qualified. There is one other large plant in the area and that is the Heavy Water Plant run by the Department of Atomic Energy. This plant uses a process which involves the use of large quantities of hydrogen sulfide gas and sulphur dioxide gas. There have been leaks of these gases to the environment in previous years, and during the survey many people even as far away as ten kilometres from the plant told us about the strong smell of rotten eggs which made life almost impossible at times. The synergistic effects of radiation and chemical pollutants are as yet not very well understood but there is no doubt that this can be an additional factor in the poor condition of the health in proximate villages.

Many people work as casual labourers in the heavy water plant as well. The heavy water plant acts not only as a production unit of fresh heavy water but also as a unit which refreshes degraded used heavy water. This latter kind of heavy water is radioactive and the casual workers do receive an occupational dose. This dose consists of not only external radiation but also more importantly workers inhale radioactive tritium and hence receive an internal dose.

Casual workers provide a true cross section of the weaker sections of our society. Studies on them would be of great relevance to a majority of the population.

Studies of radiation and nuclear industry workers all over the world have been bedevilled due to what has been called "the healthy worker effect". This pertains to the fact that while the carcinogenic effect of radiation is well established in a very large number of studies, radiation workers by and large show less number of cancers than the average population at large. As has been pointed out by Dr Alice Stewart amongst others, this dearth is due to the fact that nuclear industry workers are amongst the well to do section of the society, and they are chosen for the job after medical examinations which would eliminate weaker subjects. The casual workers on the other hand do provide a real and representative cross section of the weaker sections of our society and therefore results of studies undertaken on them would be of far greater relevance to a majority of the population.

A major deficiency of the study is the absence of any observation regarding radiation levels. Therefore, it is not possible for us to make a clear claim that radiation from RAPP is the cause of the poor health and the high number of deformities seen in the neighbourhood. What we can say from this epidemiological survey is that the health status of the people is unusually bad and this deterioration cannot be facilely attributed to poverty ignorance or unhygenic living conditions. Radiation can be a likely cause, and the pattern of disease and deformity does show similarity with other patterns seen elsewhere in the world where too radiation has been involved.

Another deficiency of this study is the absence of laboratory backup. Nowadays, with the advance of cytological techniques it is possible to undertake analysis of chromosomal aberrations of people and do what is called biological dosimetry". By this procedure it is conceivable to make a very food estimate of the radiation dose received by the subject in the past. This needs to be done and the results should be compared with the estimate* of the radiation dose produced by the environmental survey laboratories of the Department of Atomic Energy. This procedure can supplement radiation measurements and both together can be a very good indication of the damage being caused by radiation from RAPS.

1993

Discussion

During the three years after the first newt reports regarding the puzzling health condition of the people in the vicinity of RAPS appeared, there have been a number of denials and explanations offered by the nuclear establishment and the government authorities. A previous issue of Anumukti (Vol.6 No.2), in the article entitled "Lies, Damned Lies and Nucleocratic Explanations", we discussed these explanations at length. In this section, we shall discuss the results presented earlier and speculate on the various factors that might be contributory causes to the observed health effects. In the course of this discussion we will also comment on some of the various official explanations.

Disease Pattern

Reality' of the Health Effects

The survey clearly and unambiguously indicates that the health status of the people living in the proximate area is definitely worse than that of people living in the far-off villages. This conclusion is so obvious that normally we would not mention it separately. We are doing so because official spokesmen have tried to suggest that -people's health is not being affected.

"These reports are uninformed and in some cases part of a campaign to stop India from pureuing its nuclear research and power generation."

Atomic Energy Commotion Chariman
Dr. P. K. Iyengar *Hindustan* Times
179 1991

"These reports are based on conjectures and have no basis whatsoever. "

Or D.V.Goprnath, Director. Health. Safety and Environment Group at Bhobno Atomic Reseorch Centre
Hindustan Times 179 1991

"The stories regarding radiation malaffects on the population near RAPS are totally imaginary and facts being mentioned do not have even a distant relation to reality. Some highly placed RAPS officials maintain that villagers are "trying to blackmail RAPS". "These people think that through such adverse propaganda they can force RAPS to provide them with more employment and free medical facilities. "*

Pothik Guho
reporting in *The* refegrapn

It is a strange mentality which considers popular demands for a share in the fruits' of development as an effort at blackmail . However, let us pass over this point. The results of the survey clearly show that the authorities have bean far too quick in dismissing earlier reports. They have made unsupported assertions without checking the facts. There can be no dispute regard -ing the existence of adverse health effects in the proximate region.

Radiation Related?

Two separata questions form the crux of the problem. Can a hypothesis of radiation as a causative factor account for the type and the amount of differences seen in the total pattern of disease and deformities? The other question is, whether there is any possible pathway for radiation and radioactive nuclides produced in RAPS to reach the nearby villagers?

The health implications of Hiroshima studies, according to nucleocrate are an increase in leukaemia and in certain types of cancers. This, according to them is the only radiation related health effect at low levels.

We have previously, ("Lies, Damned Lies and Nucleocratic Explanations in *Anumukti* Vol.5 No.2) discussed the falsity of this claim. Let us consider the implications of starting with such a mind-set.

Cancers and leukaemia though they do occur 'naturally', are extremely rare events. To And excess cancers, over and above their natural occurrence, would require health monitoring of large papulations. Since nuclear power plants are deliberately sited in sparsely populated area, the monitoring has to be carried out over a wide area. It becomes extremely difficult to find another such sparsely populated area with similar characteristics to act as 'control' and to separate out effects due to other environmental pollutants and arrive at any meaningful result. Therefore, an acceptance of cancer and leukaemia as the only radiation related health effect, makes it very difficult to find any nuclear plant, however dirty and polluting, to be the 'cause' of health problems in a neighbouring population.

"Cancer is nothing new to this region. In recent times cancer incidence has shown an increase all over, even in regions far away from nuclear power plants."

Dleep Shotta - on engineer ot RAPS in *Janonayak.* I4,10,91

It is no wonder that with such a mind-set, expert committees appointed by the Government of Rajasthan, failed to find any evidence of "radiation-related" health effects in the villages around Rawatbhata by looking at a few people in Jharjhani, as reported by the honourable Minister of State for Science and

Technology, Shri P. R. Kumaramangalam, to the Parliament on July 29, 1992.

Moat objectionable feature of the 'survey' conducted by these expert committees was the fact that they have not bothered to publish the findings but have instead submitted a confidential report to the government. While doing this may be acceptable bureaucratic procedure, it is totally contrary to the spirit of scientific enquiry.

Shri R. Ramachandran is the science editor of *The Economic Times.* In the article entitled, "Who is Right About RAPS", *(Economic Times* 27.10.1991) he has articulated the pro nuclear position regarding RAPS. Since this article has been reprinted in full in *Nuclear India,* one can presume that the views expressed have official approval.

'There is absolutely no evidence of radiation, in any dose, leading to polio-like deformities."

This statement by Shri Ramachandran insinuates two things. One, that most of the deformities seen in the vicinity of RAPS are caused by polio; second, that-whatever is seen could not be due to RAPS since radiation does not cause polio. As can be seen from Table 9 and table 10 polio victims are not a preponderant majority amongst the deformed in either area. The prevalence of polio is not significantly different in both areas while that of congenital deformities certainly is. Radiation may not be the 'cause' of polio, but it is well known that radiation adversely affects the immune system and thus reduces the power of the body to combat disease. This phenomena of reduced immune response after radiation exposure has been seen most dramatically in Kazakhstan and in areas of Belaruss adjoining Chernobyl, where people especially children have become victims to a whole host of diseases. A new term —"atomic

The general public has been given the impress' ion that exposure to radiation involves a slight risk of dying of cancer and that one's chances of escaping this are better than the chances of escaping an automobile accident, Theprobabilities of early occurrence of heart disease, diabetes mellitus, arthritis, asthma or severe allergies - all resulting in a prolonged state of ill health - are never mentioned. Most people are unaware of the fact that ionising radiation can cause spontaneous abortions, stillbirths, infant deaths, asthmas, severe allergies, depressed immune systems (with greater risk of bacterial and viral infections), leukaemia, - solid tumours, birth defects, or mental and physical retardation in children.

Dr Rosalie Bertell
No Immediate Danger: Prognosis for a Radioactive Earth

AIDS" has been coined to describe it.

Although the prevalence of polio as well as the mean age of polio victims in both areas is similar (0.8% of the population in the proximate area verses 0.7% in the distant area) and 21 years in either case respectively, there are some differences. If we consider only children (<18 years), we find that the number of victims in proximate area (16), to be double that in the distant area (eight). Since there are a lot of other factors like the effectiveness of the polio immunisation programme involved in the incidence of the disease, it is not possible to make any definitive statement regarding it, based on these numbers.

Radiation Pathway

The argument of the nuclear lobby has focussed on the improbability of radiation in appreciable quantities reaching the people. The argument has been couched in the form of a counter-question. If the operation of RAPS is responsible for the health effects seen in the vicinity, then why have, these effects not been seen amongst RAPS' employees?

"If the main mischief maker is RAPS, then why are the children of t/ie plant workers not deformed? I (Chief Superintendent of RAPS, Dr Ramanan) have worked at the Madras Atomic Power Plant for 14 years and at Tarapur for nine years, before I came here a few months ago. Logically I am receiving much more radiation sitting on my chair here than a villager at Jharjhani or Tamlav, ,3 but am 1 affected? "3

"The reported health problems in a few villages around RAPS have not been evident beyond natural incidence in the plant workers or their families living in the adjacent plant township. It was to be noted that the limits for radiation exposure for occupational workers was 60 times that recommended for the public"

Mr. S.L. Kotl, Managing Director, Nuclear Power Corporation
Finonocial *£xpress* 21.11. 1 991

There are a number of hidden assumptions in a statement like that of Dr. Ramanan'e, some of these assumDtions are not al-

ways valid; some are outright false. But it is a statement that is often repeated by many in the nuclear establishment and it seems to impress the gullible members of the public, so let us consider it.

The response of a biological system to radiation is variable. Different people receiving the same dose, may show different effects. Apart from acute radiation disease (observed at extremely high doses in, for example, the firefighters at Chernobyl), there is no specific 'marked' disease caused by radiation. Low level radiation does not produce a low level radiation disease[9]. One of the things low level radiation does is that it makes people more prone to a whole host of 'naturally' occur* ring diseases. It increases the risk of ill health in the affected population. If a particular individual develops a specific disease that fact is not considered proof that the disease was 'due' to radiation; similarly, the fact that a particular individual hasn't developed any disease does not mean that radiation at that or less than that level is harmless. Scientists working in the field are well aware of the stochastic nature of radiation effects and yet nucleocrats will miss no opportunity to misinforfa the public by making such misleading comments to interviewers from mass circulation media.

The other assumption in the quotation above is that the regular RAPS workers are receiving larger radia'tion doses than the people living in the nearby surveyed villages. Whether this assumption is true or not depends on a number of factors. Regular workers are not a monolithic block of people all going inside the radiation fields in the reactor complex everyday. Workers consist of all kinds: operators, mechanics, security men, typists, public relation officers, station superintendents, etc. Some do receive radiation doses, some

> ***/ used to work in Waste Management.*** **Once,** ***I received a dose of 2,200 mrem in half an hour. Others have been laid off after getting a dose of 800—1,100 mrem. Most workers get this much dose in six to ten days of work. One needs to work for just half an hour to one hour every day. You receive more exposure during shut-downs. The work involves moving material. Machines are used for heavy loads, but if the load can be lifted by one or two persons, then machines are not used. My lungs have become bad. I don 't smoke. I have gone to many different hospitals for treatment. They treat you for T.B. After a few days, the doctor tell you to stop taking the drugs. Then, they restart the treatment all over again. I have developed these burn-like red marks (keloids) all over my body. One of my mates in the plant, suffers from exactly the same problem. 1 have a seven year old son. He was born with a sternal deformity. Ever since birth his rectum comes out when he shits (rectal prolapse). Despite knowing the dangers of working in the plant, people go there because they get better wages. If I have to starve, I will starve, but I will not work at RAPS.***
>
> **Manohar Singh**
> **local ledent**

don't. Similarly, the category "villagers" does not consist only of people who have never seen the inside of the nuclear power plant. In fact there are a few regular employees of the plant (storekeepers, drivers and such like), who do stay in the survey area. Besides these 'lucky' few, there are a large number who are casual labourers, many of who go to work in the reactor complex every day.

It is unfortunate but true that in India largely illiterate, untrained, poorly paid (in comparative terms) casual labourers, have to do some of the most dangerous and dirty jobs. This is not unique to nuclear industry. This applies to a lot of other industrial enterprises as well. These casual worker* do not get anv advantages like iob security, medical facilities, special schooling facilities for children, etc., that are eiyoyed by regular nuclear workers. All, these poor people get is a better daily wage than is possible doing an unskilled job outside. Nonetheless, as far as their radioactive dose limits are concerned, they are considered nuclear workers. During the survey we came across a number of casual worker who told us that they had received doses of 2,200 mrem within a few hours at a time; then they had been laid off. None of the casual workers who talked to us said that their urine had been examined after work in the radiation field for internal (tritium) exposure. Even the regular workers said that urine examination was not n regular feature after work in the radiation areas. Some had

undergone medical checkups once a year during which their urine had been examined. We suspect that the amount of internal dose to any category of workers is not known very accurately by anybody. Casual workers also mentioned to us that often they were not even monitored for external radiation while working in the radiation field. Their Thermo Luminescence Dosimeter (TLD) batches are removed beforehand and kept by the contrac tor for 'safe custody'. Therefore, Dr Ramanan's assertion that he or other regular workers get a greater dose than a nearby Villager[1] is not universally true. Only a proper dosimetry of all the workers, regular and casual, working in the plant premises and meticulous record maintenance can decide this question.

The case with the workers' health records is similar. It is a fact that RAPS authorities take no responsibility at all for the health of their daily 'casual' workers. For health monitoring purposes, such workers are considered members of **the** general public, and hence no records of any kind are kept. On the other hand, when the question is one of receiving radiation doses, these workers are considered as nuclear workers and can receive radiation doses up to fifty times the 'permissible limit' of 100 millirems per year for the general population. Although the International Council for Radiological Protection had recommended more than two years ago to reduce the permitted dose to nuclear workers from 5,000 millirems to 2,000 millirems per year, this recommendation has still not beerenforced in India.

The health records of the regular workers, if maintained are not open to outtside scrutiny. One wonders whether any long term health monitoring of the families of regular workers is ever done. The assertion that regular workers or their families living in various colonies of RAPS at Rawatbhata, "do not show any effects beyond natural incidence", is totally unsupported. The fact is nobody knows whether they do or they don't since no scientific survey has been done to establish the truth. It needs to be emphasised that such a survey would have to be scientific, and would have to compare like with like, not the well fed, well-cared for nuclear employees with the general population. Most importantly, all the results of such a survey should be published and be open for possible criti-

"I have myself seen—and reported in 1978, without being contradicted—that employees of the RAPS would work on maintenance jobs in the reactor building where the le~velg of concentration of tritium exceed 300 times the permissible amount."

Praful Bidwal

cism of the methodology. During our stay in Rawatbhata, we gathered enough anecdotal evidence to suggest that such a survey would indeed be worthwhile. It would be of immense benefit to the nuclear workers themselves, since they would get a clearer idea of the kind of price they have paid for their comfortable lifestyle working in this 'high-tech' industry.

Geography may also be a factor responsible for the health differences, if any, between people living in Rawatbhata township and those living in the villages of the survey area. There are different pathways for radiological contamination in the region. The Colonies of Rawatbhata township lie some four to eight km north of the reactors. The survey villages are the same distance north-east of the plant. The river Chambal flows north* wards. It is likely that while routine releases to air from the plant would be a greater concern in the villages, since the wind direction during the monsoons is towards the north-east, the releases to water would affect Rawatbhata mere. Some nucleocrats have publicly taken the totally ridiculous position that there is no possible pathway for radiation to reach the public, since there are no releases at all. In fact according to Dr K.S. Parthasarathy, the secretary of the Atomic Energy Regulatory Board:

"None of the two hundred and fifty shutdowns of the reactors has caused any radiation exposure to the public. Leakages do happen as in any industrial plant. Every drop of heavy water is collected. Heavy water costs several thousand Rupees a kilogram. All leaks are contained ."

This is so preposterous a statement that it takes one's breath away through sheer brazenness. The fact that the person who made it is a senior functionary of the Atomic Energy Regulatory Board makes one shudder. Suffice it is to add that in fact the amount of heavy water lost despite all attempts at recovery, runs to more than 26 tonnes every year, according to the Prasad Committee's report. During reactor operation heavy water in the reactor gets 'tritiated'. The deutrons (the heavier non-radioactive form of hydrogen) absorbs neutrons and some of it gets converted to tritium, which is a radioactive form of hydrogen. Over a period of time, this radioactivity accumulates and if there is any release of tritiated water vapour to air or to water this radioactivity finds its way into the environment As can be seen from Table 1, there is a substantial routine release of radioactivity in the form of tritium and argon-41 to the environment from the plant. Besides these "routine releases"

to air, there are releases of radioactivity to water. The disposal of "low- level" solid nuclear wastes in the vicinity, also can (if one is not careful) contribute to the contamination of drinking water supplies. Even while admitting the fact that there is release of radioactivity into the environment, nucleocrats have claimed that the radiation dose received by the most exposed people is negligible compared to the natural background radioactivity. They also claim that this dose has not shown an increase over the years.

"Environmental Survey Laboratory has been in operation over the past 19 years. Radiation surveys as well as collection and qnalysis of 2,500 samples a year of water, soil, food, cur and various other products, has been carried out in an area of about 30 km radius around the plant. The average annual radiation dose computed on the basis of actual air and water route releases over the past 17 years has been less than 5.5 mrem per annum, except 1988 and 1990, when it was about 8 and 12 mrem per annum respectively."

Mr. S L Kotl. Managing Director. Nuclear Power Corporation *Finanacial Express2)* 11 1991

'T/ie *totat radioactivity exposure from ail routes, external as well as internal by way of food etc., received by an individual in the RAPS environment has been around 1-1.7. mrem per year. The total background radiation in the area is around 81 mrem per year and the exposure limit for the general public set by international regulaioiy bodies is 100 mrem per year*."

Or D.V.Gopinofh. Director, Health. 'Safety and Environment Group at Bhabha Atomic Research Centre *Hindustan Times* 17 9 1991

The numbers in these two quotations, both from high ranking nicleocrats, vary so much that one doesn't know which figure to believe. These two statements may be dismissed as "being news releases and not meant for **a scientific audience. But the same confusion holds true for 'scientific[1] publications as can be seen from Table 1 for tritium releases and the tritium measurements in air. The numbers just do not tally. The validity of the measurements carried out by the Environmental Survey Laboratory is thereby called into question.**

***let* us see now if the observed disease pattern could be due to other environmental factors.**

Malnutrition

The questions regarding diet were asked to every fifth house-. hold. These households were randomly selected. The results show that the nutritional status of both the areas is exactly the same. The average caloric intake shows no difference and the variation in both places is similar. The average caloric intake in both places is the same as the caloric intake in an average Indian diet. The fact that the average caloric intake in both places is similar and the value is alike to that obtained by other surveys shows two things. First, it shows that our methodology is not erroneous and secondly, it rules out the possibility that malnutrition could be the cause of the health effects. Some cases of undernourishment (especially amongst children) were seen, but they were seen in both areas. It has been suggested that severe malnourishment could be the cause of higher abortion and still birth rates. The results of the survey do not support this theory.

Other Industrial Pollutants

There is no large industry anywhere in the vicinity except the atomic power plant and the heavy water plant. Both are run by the Department of Atomic Energy. In the distant region there is no large industry of any kind at all. There is no a priori reason to expect other (that is non atomic energy related) industrial pollutants to be the cause of the observed health effects.

Pesticides and Fertilizers

Large scale use of pesticides and fertilizers can be a cause of genetic deformities. However, the survey found that irrigated land and consequently, the use of pesticides and fertilizers, was greater in the distant villages, than in the villages near RAPS. Thus, any affect on this account would be in the opposite direction to what is observed.

Smoking

There were no questions in the survey questionnaire regarding smoking habits. However, if differences in smoking habits had been a significant factor, we would expect to see differences in breathing related problems, such as bronchitis, asthma, emphysema, lung cancer and the like. We did not see any such difference between the two areas.

Bacterial Contamination of the Water Supplies

"If the poor health conditions of the people reflects anything it is the dismal living, particularly sanitary conditions and near absence of any health care system. For example, the coliform count—as collected by the state government authoritie-of the water that is generally consumed by the village population is in thousands and tens of thousands when potable water should have near zero count. The bacteria levels are also very high. These can be the cause of general poor health conditions making them highly vulnerable to a whole lot of infectious and other diseases."

R Romachondion, ' Who is Right About RAPS", Economic Times 27 10 1991

Table: 16
(Central Water Commission)

Site	Coli-form /100ml	Bac-teria/ml
RAPS	9	2
Tarm lav well	>2400	150
Tamlav pond	>24,000	320
Deeppura well	240	20
•Jharjhani well 1	1100	40
Jharjhani well 2	240	95
Jharjhani well 3	>2400	170
Pump	23	10

The pattern of diseases that we observe does not support the hypothesis that water borne infections are the main cause of the health problems. If this hypothesis were true, one would expect to see not only differences in long term chronic cases of gastrointestinal tract, which we do observe; but also differences in acute infections like diarrhea, short duration fevers, conjunctivitis, urinary infections etc. We do not observe any such differences. Chronic eye problems are much higher in the nearby villages. Problems like cataract, pterygium, etc. are unrelated to bacterial contamination of water and we would not expect to see higher levels of these in nearby villages as observed, if water-borne infections were the only cause. Similar is the case with solid tumours; they are not known to be caused by bacterial infection. We observe a very large difference in solid tumours in nearby villages. The same is true with congenital deformities and cancers. In the latter case, our procedure was not capable of detecting cancer cases; we only recorded those who had been diagnosed as cancer patients by hospitals and who had the papers. Although there was a large difference in the two areas in the number of diagnosed cancer cases, it may be argued that the villagers suffering from cancer in the distant villages have not got themselves diagnosed. This is unlikely, since we found that residents of both the areas were going to doctors and hospitals for chronic ailments; in fact the villagers in the distant area found it easier to get to Rampura and 'proper' medical attention than those in the proximate villages.

More than 38 percent of the population of the proximate villages get their drinking water either from the tap (see Table 7) or from hand-pumps. Construction work is presently going on in the Anushakti complex on RAPP-3 and RAPP-4. The skilled migrant construction workers who live in a colony near Tamlav demanded a better source of drinking water than those available. It was due to these reasons that a tap water supplies were provided since last two years. These supplies are comparatively uncontaminated. If bacterial contamination were the main cause of the observed disease pattern, one would expect a far smaller number of health related problems in those households using these /supplies as compared to other households in the same villages using far more contaminated sources of water. We do not find any such correlation.

The general state of sanitation in both the areas is similar. This is a somewhat subjective assessment, but there is some tangible evidence in support of this conclusion. If we look at the pattern of infant mortality in the last two years, we find that there is a large difference in the number of still-births and one day neonatal deaths. There is no difference in the numbers of children who have survived the first day but who died within the first ten days. There can be many factors responsible for the difference in one day mortality, including the quality of obstretic care and genetic factors. Later mortality is more dependent on environmental factors like cleanliness and possibility of infections like tetanus etc. The lack of differences in these mortality rates lends weight to our subjective assessment that both areas were equally clean/dirty.

The high incidence of chronic gastro-intestinal tract infections that we observe in nearby villages, could of course be possibly due to the unsanitary condition of drinking water. This may also be a factor in the unusually high skin problems. One needs to add a caveat that a detailed breakup of different skin problems would not totally support this contention since we observed much higher numbers of people suffering from hyperkeratosis and hypopigmentation in proximate villages as compared to the distant villages. Water borne infections are an unlikely cause of these problems. Similarly, we found four men in the proximate area whose whole bodies were covered with large keloids. Keloids are not unusual in case of injury or puncture of the skin. Yet, all the four gave no history of iryury. They maintained that their condition had started as a small (pea sized) lesion and had grown to its present gigantic size. There were no such cases in the distant villages and this condition is again unlikely to have been caused by water borne infections. Since we do not have readings of the bacterial and coliform counts in drinking water in the distant villages, it is not possible for us to make any categorical statement regarding the role of drinking water in the pattern of disease. In fact, for all one knows the water quality in the far off villages may be equally bad, and the Rawatbhata readings are just the 'normal' for rural parts of central India. One finds that civil health authorities have known about the 'undrinkability' of water supplies in the proximate area for years, but have remained unmoved. Is bacterial contamination of water as unsolvable a problem as that of the disposal of nuclear waste?

Congenital Deformities

Let us again start here with the official position

"On an average ten percent of all new born children will have some defects or the other. They include cleft palate and additional fingers. The birth defects can be seen in any village."

Dr K S Parthasarathy Secfetory
Atomic Energy Regulatory Board
Times of India 13 9 1993

What constitutes a birth 'defect? When Dr Parthasarathy talks of birth defects he might be including very minor conditions like skin tags, birth marks, etc. These minor conditions have not been included in our survey. The number of deformities detected would also depend on the skill and the instruments used for detection. Thus, X-rays and sonography techniques would detect some occult internal organ deformities that may not be apparent to the naked eye. It should be noted that the ten percent figure quoted by Dr Parthasarathy is much too high . and not supported by any study of congenital deformities done in India.

Unfortunately, there is a dearth of studies on the prevalence of congenital malformations in rural populations in India. Available data (see for instance references given in Dr I C Verma's authoritative book "Genetic Disorders in India"), are mainly concerned with incidence in hospital births in urban settings in which all births are examined by doctors and which also include autopsies of stillbirths and dead children in some cases. In a prevalence study like ours, the detection of congenital malformations is likely to be much less, since the chances of survival of individuals with life-threatening malformations are **slim and hence they would not be observed. It is known that 70% of deaths due to congenital malformations occur during the first year of birth. Also hidden internal organ malformations are likely to be missed in our procedure.**

The only large prevalence study of the general population in India was carried out by the Anthropological Survey of India. This survey was conducted in 96 locations spread over 14 states and covered 47,974 individuals. The frequency of major and minor defects was 9.8 per 1,000 though considerable regional variation was observed. Unfortunately, despite all our efforts, we have not been able to receive a copy of this study and have had to rely on the references to it in Dr I.C. Verma's book. Although we are not able to make detailed comparisons regarding prevalence of deformities in different age groups, the percentage of deformities that we find in the distant villages is well within the range of this study, while those in the proximate villages are significantly higher This study also found that in the general population there was a marked preponderance of musculoskeletal deformities, which we too observed.

Last year my baby died. He was one year old. He had a big swelling between his buttocks. He was born like that. He never learnt to sit. We took him to many doctors in different places. A lot of money was spent but to no avail. He died.

Sojano
locolResdent

Hospital studies from various regions report a very wide variation (ranging from 37.9 per 1000 to 2.5 per 1000) in the incidence at birth of deformities. The last two year's births in our study show that the deformities at birth in the distant villages (15.2 per 1000) fall well within the above range, whereas those in the proximate villages (77.5 per 1000) are much higher. Deformity studies in the state of Rajasthan (which also include stillbirths) have reported an incidence ranging from 17.3 to 21.3 per 1000. They have reported a high incidence of neural tube defects which were responsible for considerable stillbirths and neonatal deaths. It seems likely from the description given by mothers and midwives that a good number of deformities seen in stillbirths and in babies who died soon after birth in the proximate villages could have been due to neural tube defects.

Reports from the Pickering nuclear power station in Canada (see *Anumukti* Vol.5 No.2), indicate significant increases in the incidence of various birth defects. As can be seen from Table 1 routine emissions from RAPS are on a larger scale than those from Pickering. The recorded occupational dose to workers is also much higher at RAPS. A point which needs to be considered in this connection, concerns the dietary and hygienic habits of the local population as compared to that in Canada. If there is radioactive contamination of the land and water sources due to routine emissions, the effects are likely to get accentuated in Indian conditions where people eat far more locally grown food than their counterparts in Canada. Similarly, our habits of defecating in the fields are likely to help in the recirculation of radioactive contaminants.

Early Deaths

Scientists at the University of Bremen in Germany noticed in 1986 that one-day mortality in newborn babies, during the months following the Chernobyl registered a sudden rise in those areas of the country which had been most effected by the radioactive fall-out due to the accident Northern parts of Germany which had remained relatively unaffected by the fall-out, did not register any such rise in deaths amongst one-day olds. Although Chernobyl was a massive disaster and involved the release of millions of Curies of radioactivity, the affected region of Germany is more than two thousand kilometres away, and the radiation dose received by foetuses in the wombs of their mothers there, was not greater than that received regularly by foetuses in villages surrounding RAPS.

The British Medical Journal of 9th February, 1992 (vol.304 pp 343-6) carries a study by Prof. RK.Whyte of McMaster University, Hamilton, Ontario, Canada

A Note on Untoward Pregnancy Outcomes

From a Testimony by Prof. Eva Alberman

Untoward outcomes comprise:

. Complete loss of fertility resulting from the most severe degrees of damage to male or female reproduction.

. A reduction of fertility whether in the male or female partner.

. A conception which is impaired. This impairment can be due to any of the following causes.

- **An inherited genetic defect which may have been passed through the germ-line of either parent, e.g. familial retinoblastoma or cystic fibrosis**
- **Because it may have been exposed to a mutagenic influence prior to conception leading to damage to the fetal genetic material for example, sporadic or non-familial genetic disorders**
- **Because the earliest cell divisions result in an aberrant chromosomal constitution, the origin of which may be traceable to either parent, e.g. Down's syndrome:**
- **Because it has been exposed to teratogenic (tending to produce fetal monstrosity) influences, leading to other than genetic damage, the effect often being modified by other genetic and environmental influences (multifactorial effects). Teratogens act after conception; examples would be the thalidomide drug or maternal exposures to high doses of radiation leading to fetal microcephaly.**

Sita had a baby. Couldn't drink milk. Was soft like a quilt. He was deformed. Lived for a short while. Chousar Bai had a son. Soft, very soft. He was born dead. No movement in the abdomen for more than a month. I attended three miscarriages during the past year.

Kes Bol
Local Midwife

which, demonstrates a correlation between atmospheric atomic bomb test in the 50s and 60s and rise in infant mortality. The high statistical correlations indicate that there was an excess of 320,000 infant deaths in the period 1950. 1980 in the USA and UK alone. All first day infant deaths, neonatal deaths (within the first 28 days) and still-births were included in this study.

In a memorandum on the implications of the Whyte study, Dr Sternglass says that today, there could be millions of persons aged 10 to 45 years who have been harmed by the atomic bomb tests because some ten times more underweight babies survived who, nonetheless, frequently showed physical and mental problems. Therefore the greatest health and economic damage through fallout would not be increased rates of leukaemia and cancer among children, but instead an increase in premature and under-weight births. This would result in increased infant mortality, impaired pregnancy and immunological deficiencies in children that survive. For every thousand live births the number of underwieght babies is some 100 times greater than that of children dying from cancer and leukaemia.

We can see very clearly prom Table 11 and Table 14 that untoward pregnancy outcome* are significantly higher in the villages near RAPS.

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A Look At The Bright Side of Nuclear Energy

Reading *Anumukti* is generally a depressing experience. It is full of news of nuclear follies and disasters, radiation spills, cancers, deformed children and such. Don't you think you and your readers are entitled to some cheerful news ? I think so. consider the following.

The AEC has stated that India has a target of 5800 MW for nuclear electricity by 2001. Considering that we were being threatened with 20,000 MW of it in the mid 70's, this is indeed good news! The target was reduced to 10,000 MW in the 80's. Further, the bulk of this revised burden is sought to be inflicted on us through the 'advanced' 500 MW reactors Since these advanced reactors have not advanced beyond the drawing board, we can expect a further lowering of target in the coming years. I think chances are bright that we will enter the next century with no more than a dozen reactors working at 30-40% of their capacity.

An atomic power plant working below capacity should also be treated as good news. A 100% power efficient reactor produces more than twice the radioactive pollution and wastes compared to one working at 50%. Radioactive effluent treatment plants designed for a 235 MW reactor will work that much better if the reactor works only at about 150 MW. 1 am not suggesting that radioactive discharges from our nuclear reactor are actually being contained, but these discharges could have been much worse had the reactor operated continuously.

The safest reactor in the world is the one which has not been built. But among the ones actually built, the safest reactor is the orw which is not working. Since our reactors spend more.than half their life in this highly desirable state, the margin of safety, on the lives of people around also increases proportionally. A nuclear power plant in coma may be a financial loss. But it saves human lives, produces less waste to burden the future generations and is easier to decommission too! Frequent tripping off of atomic power plants also sends the right message to the state electricity boards - nuclear power is unreliable. In a globalised, liberal economy, where efficiency and cost effectiveness hold the key to survival, we can surely look forward to the well deserved demise of atomic energy as has happened in UK. All anti-nuclear activists in India should also thank BHEL whose turbines have progreased from breaking their blades, which needed a few months to repair, to going up in flames which can shut down the reactor for more than a year. No matter how righteously the nucleocrats proclaim that the turbine breakdowns have nothing to do with reactor operations, what counts ultimately is the number of units that the power plant as a whole delivers to the grid. BHEL, whose faulty turbines contribute significantly to lowering that count as well as radioactive discharges, is entitled to at least a certificate of merit for "outstanding contribution by a Public Sector Undertaking towards the environment".

Did you know that a nuclear reactor can be imported by practically anybody in India? Time was when the babus in different arms of the

government decided what was to be imported and what was not. These worthies used to dictate exactly how much groveling you had to do before they favoured you with an import license. Not any more. Thing's have changed under Manmohanomics. There is only a short "Negative list". Anything not explicitly banned under this list can be freely imported. And a study of the list reveals the surprising fact that only radioactive materials are excluded. If you have the fuel and the funds, you can import any reactor of any design, including graphite moderated ones from Chernobyl.

There is a catch, though. Under section 84.01, Sub headings 8401.10 to 8401.40 of the Indian customs Tariff as amended by Union Budget of 1993-94, nuclear reactors and parts there of as well as fuel elements (cartridges), non irradiated of course, attract the highest duty slab of 80%. An year ago, the duty levied on these same items was only 60%. In other words, a nuclear reactor imported in 1993-94 would be 20% costlier than in 1992-93. One suspects some sort of connection between this and the not-yet- totally-dead issue of Russian reactors at Kudamkoolam. Perhaps a wiser reader may throw more light on this.

Plenty of light also needs to be thrown on the solar village planned by the Dept. of Non Conventional Energy Sources. (I have always wondered why something as natural as sunshine or wind should be dubbed as 'non-conventional' and a convoluted technology like N-power be accepted as 'conventional*. There certainly is a need to change our conventions.) The village of Kalyanpur in U.P has gone fully solar and is to be inaugurated by no less a dignitary than the PM, in April. True, the funds allotted for such endeavors are meager and their main role is perceived as substitutes for the petroleum products, but **these are** the first, faltering steps in the right direction. Let us hope that our non-conventional energy projects get managed much « better than the conventional energy projects get managed much better than the conventional ones.

Last but not the least, the disinformation campaign launched by our beloved editor of Anumukti is having the desired effect. We **all** know he is bluffing when he threatens to double the subscription rate overnight. Even nuclear costs do not rise that rapidly. Still, I am not taking chances. Dear Editor, your cheque for Re 260/- for a lifetime subscription is enclosed.

Sonjoy Havonur

Unlike nucleocrats, I don't bluff when it comes to money. See the subscription rates on the last page.
— Editor

From the Editor's Desk

Are Courts the Answer?

After hearing all the arguments in the petition praying for the reconsideration of the decision of the Government of India for locating the atomic power plant in the midst of a tropical rain forest at Kaiga in Karnataka, the Supreme Court on 7th May, 1993 passed the following order:

'The Centred Government will consider the report of December, 1990 submitted by NEERI (National Environmental Engineering Research Institute) and also the written submissions that may be forwarded by the petitioners to the Secretary, Department of Atomic Energy of the Government within four weeks of today, and will take its final decision in the matter of establishing the atomic power plant in consultation with the concerned departments including the Department of Environment. If the Government so desires, they may also hear the petitioners in person. However, it is made clear that it is not obligatory on the Goveminent to hear them.

Does this order represent a victory or a defeat for the antinuclear movement? Friends in Karnataka were jubilant and said that Sharavati Tail Race hydroelectric project had been shelved after a very similar order of Karnataka High Court. But nucleocrats have been equally happy claiming that the order dismisses objections to Kaiga. Have things come to such a sorry pass that we have to go through this involved, time and money guzzling procedure just to be able to present our grievances to nucleocrats, who may if they so desire give us a hearing"? Is the legal process worth the hassles?

I believe that it is only a strong people's movement which will make the operators who run the system listen and eventually adopt a policy of sanity which would respect people's rights and the environment. Deliverance will not be handed down on a platter by anyone be they learned judges and powerful politicians in New Delhi or enlightened bureaucrats in the World Bank.. First of all, these worthies need to be educated themselves. Only a people's movement can accomplish this stupendous task. Let us not waste any more effort in frivolous pursuit.

Implications of the Near Miss at Narora

How long can operator skill and heroism overcome absence of safety culture?

Indian drivers are usually quite skillful. They have to be. The condition of our roads, the diversity of our traffic and the near total absence of traffic rules makes skill a necessary condition for survival. Yet, India has one of the highest casualty rates for road accidents in the world. If one considers the fact that traffic in India is much slower than in other parts of the world, then this anomaly becomes all the more apparent. Skill alone cannot overcome the inexorable laws of probability. It cannot be a substitute for a safety culture.

The near catastrophe at Narora on March 31, 1993 brings this lesson once again to the fore. Deplorably, the lesson is unlikely to be learnt. The handling of the 'incident[9] by the nuclear establishment is in striking contrast to its handling by the junior operating staff at the plant. The plant staff showed both a heroic calmness under stress and quick witted innovative thinking. This ingenuity and dedication to duty needs to be recognized and rewarded. In contrast, the top rung of nuclear establishment plumbed new depths of negligence, dissimulation ami self-congratulation.

The Facts

Even after four months, facts regarding what actually occurred are still unclear. The expert committees appointed to look into the causes have submitted their reports but even they have failed to reach a consensus regarding the cause of the fire. Let us recount the facts which are not in dispute.

- **The fire started in the graveyard shift at 3.31 AM.**
- There was a loud explosion which was heard by many people.
- At the time, the reactor was operating at 190 MW.
- The fire originated in the turbine room which is some distance away from the reactor building.
- It continued for close to two hours, whereas smoldering of cables continued till 8.30 AM.
- The fire caused extensive damage to the generator and power supply cables.
- The reactor was tripped manually by the station staff on duty when they noticed that the turbo-generator had automatically tripped after the fire.
- The fire tenders in the turbine hall proved inadequate to control the fire since the flames reportedly spread to the lubricant and sealant oil drums kept in the hall, and the entire structure housing the turbine was damaged.
- Fire extinguishing efforts were hampered by the large amount of smoke emanating from burning wires and parts of the generator.
- Smoke detectors did not work.
- During most of this time the control room of the reactor unit was filled with smoke. The emergency control room—-a special safety feature at NAPS—was rendered useless in the absence of emergency power supply. Narora Unit Two had been shut down for several months, after a generator identical to that in Unit-1 was reportedly damaged on account of overheating.
- The most serious aspect of the fire was that there was complete loss of station power for a period of 17 hours.
- None of the three emergency diesel generators was able to work, since the cables connecting them also burned down.

Defense in Depth

Since the consequences of a nuclear accident are so horrendous, nuclear reactors are equipped with redundant and independent safety systems. The idea being that even if some safety systems malfunction in an emergency, there would be others to do the job and ensure safety.

Of primary importance is the safe shutting down of the reactor. In Narora, there are two fast acting shut-down system*. The primary shut-down system consists of 14 control rods made of cadmium. These cadmium rods drop into the reactor core under gravity whenever a trip signal is received. They halt the fission reaction in less than two seconds. Besides the primary shut-down system, there is a secondary shut-down system as well. In Narora, this consists of filling up 12 vertical cores in the reactor core with lithium pentaborate solution. Boron has an extremely

high neutron absorption cross section. Thus any neutron which comes in contact with a boron atom gets absorbed and thus unavailable to continue the fission reaction. According to newspaper reports, both the fast acting shut down systems are further backed by the automatic injection of controlled quantities of a boron solution into the reactor's moderator system. Even if there is complete electricity blackout in the station (as did happen at Narora) and the secondary shut down system cannot work, this arrangement ensures the addition of boron to the moderator under gravity.

The operating staff on duty noticed the smoke coming out of the turbine room and realized from the control panel that the fire had tripped the generator. The primary shut-down system was immediately initiated and it did work. Based on the reports it is apparent that the automatic injection of boron into the moderator system under gravity also worked. In any case the fission reaction was successfully halted. A question that comes to mind is that why was it necessary in this case for the operators to initiate the shut- down system? Shouldn't it have taken place automatically? Perhaps, some technically qualified readers can throw light on this point.

In a nuclear reactor halting the fission reaction is just the first step. The fission of uranium produces a large variety of radionuclides which continue to 'decay[1] and give off additional amounts of energy. This decay heat is a substantial amount—nearly seven percent of the reactor's heat at full power—which needs to be removed to maintain the integrity of the reactor. Thus, even after the reactor is safely shut down it needs to be continuously cooled.

Senior nucleocrats have waxed eloquent on the Indian designed 'passive' cooling system which performed this cooling. Number of newspapers had headlines reading "Passive Cooling System Saved Narora Reactor." RRamachandran, the science editor *of Economic Times,* has written an article entitled 'Thermosiphoning:

What if Shutdown Systems Fail? Catastrophe!

CANDU reactors like the ones at Narora (U.P.), Kakrapar (Gujarat), Kalpakkam (Tamilnadu) and Rawatbhata (Rajasthan) share an unhappy feature of Chernobyl (RBMK) type of reactors. The technical term for this feature is "positive void coefficient of reactivity". The nuclear fission reaction tends to increase rather than decrease as the temperature of the reactor core increases and more heavy water coolant gets boiled off. This leads to an uncontrolled runaway increase in the reactor's power level as happened at Chernobyl. Safety studies conducted on the CANDU type reactors show that a failure to shut down the reactor when required, would result in a complete failure of other safety systems and a reactor 'disassembly'. Nuclear engineers consider this simultaneous failure of the three separate shutdown systems as an 'incredible' event against which no defense can work.

Pascal

alone did it *(Economic Times* 10.4.1993) which describes rather well the way this cooling was accomplished in the absence of electric power to drive the primary heat transport pumps. The following four paragraphs are a quote from this article:

"Indeed, the incident has helped validate a passive cooling system built into Indian Pressurised Heavy Water Reactor (PHWR) design for safe shutdown of the reactor. The system is based of what is called thermosiphoning which enables circulation of the coolant in the core of the reactor when power supply to the reactor gets disrupted, like in the present incident,

and power for forced circulation of water with the aid of pumps and the like then becomes unavailable.

"Under usual reactor shutdown conditions, forced circulation of primary coolant, by keeping the primary pumps running, ensures this. Even if the primary pumps fail, there is an auxiliary diesel generator available which can be pressed into service. But in situations of complete station blackout like last week (when even the cables leading to the diesel generator line got burnt), though the reactor shuts down, the heat generated by decaying fission products needs to be removed quickly.

"Initially, soon after the reactor trips and power supply to the pumps fails, the coolant circulation is provided by the flywheels mounted on the pumps whose coasting down achieves the necessary initial circulating flow. Subsequently thermosiphoning principle takes over and maintains a natural circulation of the primary coolant. This thermosiphon flow should be adequate to transfer the decay heat to secondary coolant in the steam generators (SGs). Thermosiphon flow is an important design feature and enhances the safety of the reactor under off-normal conditions.

In fact, only in December 1992, an off normal situation was simulated in the NAPS-1 core and adequacy of thermosiphon cooling studied. Though such studies are routinely carried out in reactors abroad, this was the first such test in an Indian PWR. The tests had found that the cooling due to thermosiphoning was as predicted According to the scientists of Bhabha Atomic Research Centre (BARC), who con-

ducted the simulation studies, the real-life situation of a power failure proved that this auto-cooling was adequate,"

What Mr Ramachandran has forgotten and what high ranking nucleocrats have conveniently left unsaid, is the fact that primary heat transport system cannot go on cooling if it in turn is not cooled. There is only a limited amount of heavy water in the system and after removing the heat from the reactor core, this heavy water gets hot. During normal operation, the hot heavy water under pressure is cooled through a heat exchanger where it heats ordinary (light) water in a secondary (steam generator) circuit. This secondary system water becomes steam and is used to run the turbines to produce electricity. However, due to total station blackout, the secondary system's pumps also could not work. It was here that the station's operators showed ingenuity and courage. Their heroic role is mentioned in a report in *The Hindu* on April 4 and is also recounted in Ms. Rupa Chinai's article "Narora: When Emergency systems' fail in *Sunday Observer* of April 18, 1993. The following is an extract from her account:

"While the Primary Heat Transport (PHT) System remained intact with heavy water supply; the loss of power prevented circulation of light water from the boilers, which served to cool the PHT system and transport heat from futl to the boilers. Thus, the removal of reactor core heat was retarded

"ln the few minutes before toted power was lost, the operators managed to open the 'Safety Blow Off Valves' to start the cooling process in the reactor, enabling steam to be released.

"But they still had to feed the boilers, which began to run out of light water. This was manually accomplished with the use of fire fighting pumps funning on their dedicated diesel generator, transporting water to the boilers after the valve in the outer containment of the reactor was opened. This was possible because of the hemic efforts of individual reactor operators, who risked exposure to heat and possible radiation, when they reportedly entered the outer containment shell of the reactor to manually open a valve, thereby ensuring water flow to the reactor boilers which in turn controlled temperatun of the reactor core. By this they averted severe damage to the reactor core."

Despite the much trumpeted claims of nucleocrats, it was not only the •passive' cooling system "designed by Indian scientists" which prevented core damage. It was the brilliant thinking which utilised the diesel generator of the fire-engine to provide 'active' cooling, and the fact that unlike nuclear "defense in depth" safety systems, fire engine diesel generators do work, which prevented a debacle.

The operators deserve the nation 's gratitude for saving it from a disaster in one of the most fertile and thickly populated regions of the country. But what about the senior nucleocrats and ignorant politicians who have put Ganga Mai under this everlasting threat?

A word needs to be said regarding this "designed by Indian scientists" nonsense. I would be the first to cheer any genuine expression of In* dian creativity, but frankly, I find this attempt to pat one's own back on totally undeserved grounds, disgusting. The "passive[9] cooling occurs due to the way the primary heat transport system has been designed and the design in Narora is no different in its general layout from that of other CANDU tractors operating elsewhere in the world. Thus, if credit has to be given for this passive system, it should be given to the original Canadian designers of the CANDU type of reactors.

The Cause of the Fire

All accounts agree that the initial cause of the fire might have been a spark caused by a fault in the electrical system, somewhere in the cable tray underneath the turbogenerator. However, there are wide variations in versions presented by various high-ranking nucleocrats in different newspapers. The version presented by M. Satish and R. Ramachandran in *Economic Tunes* of G.4.1)3 where they quote Dr. Chidambaram, the Chairman of the Department of Atomic Energy is as follows:

"The smoke sensors in the power control room did not detect the fire in the generator area immediately, Dr. Chidambaram said, probably because the smoke itself did not build up for some time. It was also around this time that many persons reported hearing a loud blast, akin to an explosion.

"The "explosion" seems to have occurred during the long coasting down period of the shaft from its high rotor speed of 3000 rpm, the AEC chairman disclosed

"According to investigators, the reason for the explosion could be something like this: as the shaft began to reduce speed, some of the burning cables nearby may have got entangled in it, applying severe instantaneous torque in the reverse direction. The "explosion" could thus turn out to be the massive sound created as a result of a damage or breakage of the coupling shaft. What adds credence to theory is that most non-inflammable parts of both the stator and the rotor of

the generator are said to be intact, and can be salvaged."

In the same article, they expressly add,

"Most fires in hydrogen-cooled generators in the past have been caused by leaking hydrogen.. Whereas in the case of NAPS, no untoward pressure drop in the hydrogen circulation was noticed."'

The Director of Engineering at NAPS, Mr G. Ghosh, also ruled out hydrogen being the cause of the fire saying, "*the area was so wide and open that for a hydrogen explosion to take place, there would have to be a very large leak of hydrogen and this was not possible because the level of hydrogen was monitored continuously.*"

As opposed to this we have the previously referred April 4th report in *The Hindu* and Ms Rupa Chinai's article in the Sunday Observer where there is a totally contradictory version of events. To quote:

'Technical inquiries by experts have so far reportedly assessed the fire to be the result of a fault in the electrical system, and leakage of hydrogen gas within the generator. The consumption of hydrogen gas required by the generator, had shown an increase over one week, pointing to an internal leakage of the gas.

'This, however, did not give rise to a general alert from those manning the control room. Reportedly, no effort was made towards remedial measures. It is thought that hydrogen, which is used as a coolant, could have triggered the fire, which erupted from either the cables or oil."

The Official Version

The official press release put out by the Atomic Energy Regulatory Board on July 8th, that is well after the inquiry committee submitted its report, is silent regarding previous leakages of hydrogen.

"Failure of two turbine blades resuited in a severe imbalance of the large rotating mass, causing extensive damage to the bearing of the machine as well as to the various accessories and components of the turbine and the generator. In the process, the leak-tightness of the generator hydmgen seals was lost, leading to a hydrogen leakage and a fin."

Nucleonics Week, the nuclear industry journal published from U.S.A. knew the contents of the committee's report far in advance of any Indian newsmedia. In its issue of 17th June, 1993, it states:

The inquiiy committee set up to investigate tlie 31 March fire at NAPS is split on the cause of the accident, and the DAE may be presented with two reports. One section of the committee says that the fire was caused by the shearing of two turbine blades Which in turn was caused by fatigue inflicted on them by frequent grid disturbances. (Voltage control on the Indian grid is often erratic, with brown-outs and black-outs not uncommon.) The other section of the committee has traced the cause to a duct at the generator busbar coming loose. This means, in effect that the generator maintenance was at fault and not the turbines.

Public Safety Issues

Madhusudan Srinivas in his article The Narora Fire and the Communication Gap" in *Frontline* brings out the public safety aspects of the fire.

"Though emergency drills have regularly been rehearsed since 1989 (one had been scheduled for 11 cum. on April 1), when the real alarm went off at 3.35 a.m., the immediate reaction was panic. For some two hours, there was no official communication—either from the plant authorities or the district administration—to the inhabitants around NAPS. Between the relent-

Not A Day Too Soon

The Atomic Energy Regulatory Board's directive to the Nuclear Power Corporation to sequentially shut down all CANDU type reactors for a thorough inspection of the turbines, generators and associated components is not an instance of a 'smart' regulatory body on the job but rather a case of "too little, too late". Consider

Madras Atomlo Power Station Unit-1 (July 23,1983)
Site emergency declared due to fire In the boiler room.

Rajasthan Atomic Power Station Unit-2 (July 25.1985)
Unit operating at 190 MW. "Catastrophic" fire in the boiler room

Kakrapar Atomic Power Station Unlt-1 (September 15,1991)
Fire in the boiler room during testing before reactor opening causes extensive damage, delays opening by nearly one year.

Yet a fire in the same spot at Narora when the reactor was operating at 190 MW! isn't It time AERB realised that BHEL generators are unsafe while operating nearfull power ?

less wail of the alarm and the darkness around the plant (which is normally brightly lit) the villagers were left to draw their own conclusions. By the time the authorities sent out the information that the fire had been brought under control and that there was no radiation leak, large numbers of people had packed their bags and a few had actually fled."

According to a report in *Safe Energy and Environment,* NAPS authorities had asked the District Magistrate to keep 2,000 buses in readiness for evacuating the people if necessary, but the Magistrate had expressed his inability to do so at such short notice. This news, if true, is an eloquent comment on the state of emergency preparedness near nuclear facilities. Do the authorities think that emergencies will come with adequate prior notice? Probably civil authorities are competent to arrange buses only for political tamashas where they have enough advance warning.

Incompetence at the Top

"The chairman told newspersons on Monday that the fire was 'unusual' because of its magnitude and location, which was below the turbogenerator—"a very unlikely spot."

'New panel fo probe Naroca mishap"
Observe Economic Bureau
Observer of Business & Politics 6.4 \ 993

"July 23, 1983:
Stand by emergency was declared to fight the fire in unit-1 (MAPS) boiler room and below the TG"

•Review of Rodtatton Emergency OrWs and Actual Emergencies Declared at Madras Atorrtc Power Station'
S. Paramesvaran, R. S: Vocodhan. T. S. V Ramanan
Thrid National Sympotfum on Operating Experiences of Nuclear Reactors & Power Plants

How many fires need to start under the turbogenerator, before Dr Chidambaram considers that as a likely spot and takes appropriate precautions?

"Wepropose to make improvements in electrical cables like fitting survived cables and fire barriers."

Chairman of the Nucleou Power
Corporation, Mr S K Chotterfee,

What was Mr Chatterjee doing after the RAPS fire of July 25, 1985? Should these Improve* ments not have been made at least then as one of the lessons learnt (see following article).

Lessons that the Public Needs to Learn

Fires in nuclear power plants are nothing new. Fire at the Brown's Ferry nuclear power plant in the U.S. as early as 1975, had demonstrated common mode failures. (Failures of multiple standby safety systems as happened at Narora). It had highlighted the need to isolate cables controlling independent safety systems. Although the Brown's Ferry fire took place before any substantive construction had even begun at Narora, this elementary precaution seems to have escaped the designers.

Even within India, the Narora fire is not the first instance of a major fire in a nuclear power station (see following article). But the nucleocrats have been behaving as if it is.

The main lesson the public needs to learn from the near miss at Narora is that nucleocrats and politicians will never learn and public safety can only be ensured when the public itself forces a closure of these deadly, demented machines.

There is another small lesson which too can be of immense benefit to the public. Like the dog in Sherlock Holmes' story, the smoke detectors in nuclear plants never seem to bark. The Nuclear Power Corporation would do a lot of good if they would only publicise the type and make of their smoke detectors so that the public would know which detectors to avoid. In all probability, these smoke detectors are the ionising type which *use* radioactivity of Americium-241. Nuclear authorities should immediately themselves switch over to nonradioactive smoke detectors which use photoelectric cells and advise the Atomic Energy Regulatory Board to ban ionising smoke detectors which don't work and are a serious source of radioactive pollution.

Surendra Gadekar

The main lesson the public needs to learn from the near miss at Narora is that nucleocrats and politicians will never learn and public safety can only be ensured when the public itself forces a closure of these deadly, demented machines.

A Wasted Warning

Lessons Not Learnt from a Fire in RAPS in 1985

The Narora fire of March 31, 1993, despite newspaper claims of nucleocrats to the contrary, is not the first time an operating nuclear power plant in India has come close to the brink. Rajasthan Atomic Power Station (RAPS) for instance, suffered a serious fire in 1985 within the reactor building itself The official account of this fire has been published four years after the event in an obscure Bhabha Atomic Research Centre publication and makes chilling reading, Although written in a nuclear engineer's jargon, we reproduce it in full and provide a glossary which we hope would be sufficient to decode the officialese.

Handling Experience of Reactor Controls During Large Cable Fire Incident

R. Venkata Raman

Third National** Symposium on **Operating** Experience **of Nuclear Reactors & Power Plants
March* 15-17,*1989

25th of July 1985 was a critical day in the operation of Rajasthan Atomic Power Station (RAPS) Unit-2. On this day, when the unit was operating at 190 MWe a catastrophic fire ignited in boiler room. The resulting inferno disabled many vital instruments and indications, jeopardising reactor safety.

In spite of the non-availability of important indications and display of many false system status indications, the station operating staff managed to bring the reactor to a safe shutdown condition, thus averting a potentially dangerous situation.

Brief Chronological Description of the Incident

10.12 Heat Transport Pump No.2 tripped.

10.13 Reactor tripped on high differential temperature followed by turbine trip.

10.18 Reactor was reset and fast start initiated.

10.22 Heat Transport Pump No.9 stopped for 3-3 pump mode operation, but the pump tripped immediately. All the heat transport pumps had tripped due to ground fault and instantaneous overcurrent as observed from their respective breakers subsequently.

10.26 Suspecting major problem, station startup was abandoned, reactor was scrammed and crash cooldown was initiated.

During the above period, the following safety systems got actuated:

1. Emergency Injection Operation indication appeared.
2. Dousing system Red Lamps for valves closed position disappeared, indicating possible unlocking of the valves, preparatory to operation.
3. Reactor Building got Box-up.
4. A number of critical 48 Volt supply fuses blew making connected loads non-operational.

Also the following critical systems became unavailable:

1. . . Heat Transport System Pressure Control on wide range.
2. Floor beetles in boiler room got actuated spuriously, wrongly indicating large water leak in boiler room.
3. Valving in of shutdown cooling system became inoperative due to spurious initiation of Emergency Injection.
4. The fire and smoke detection system alarmed only at 10.35 hours (23 minutes after the incident), delaying **protective measures till then.**

There were six indications that ruled cut the possibility of a large leak either from the Heat Transport System, Secondary System or the Process Water System.

1. **Heat Transport System Storage Tank level was steady.**
2. **Boiler pressure and feed water pressure were steady.**
3. **Boiler levels were steady.**
4. **Low pressure and high pressure process water system pressures were steady.**
5. **Area Radiation Monitors registered normal values at this time.**
6. **Boiler room pressure was normal**

Actions Taken

Acting on the above basis, the following actions were taken by control room personnel, despite the above handicaps:

1. **Spurious actuation of the Emergency Injection system and possible actuation of the dousing system were blocked.**
2. **As heat transport pressure recorder was reading off-scale, controller malfunction was suspected and**

A Glossary of Technical Terms

3-3 Pump Mode Operation

The steam generator is operated with an equal number (three) on both sides to maintain balance of pressure in the reactor.

Ground Fault

Pumps are operated by motors connected to the electrical power supply. If a point on the winding becomes connected to the ground on account of damage to insulation, a large current (an overcurrent) may flow. This is sensed by the protection equipment which opens the circuit breaker thus disconnecting the motor from the power supply.

Dousing

This is an emergency water spraying system to reduce the steam pressure inside the containment building in the event of a steam leakage and pressure build up to prevent the possibility of a steam explosion.

Box-Up

The reactor building gets isolated from the outside by closure of dampers in the ventilator to prevent escape of any radiation which may have built up.

Emergency Injection

The Emergency Core Cooling System (ECCS) will iryect cooling water into the Primary Heat Transport System (PHTS) when

pressurising pumps were put off.
3. Shutdown cooling system was valved in by jumpering the emergency injection logic and the system maintained solid by starting the auxiliary pressurising pump (Fueling machine supply pump) and maintaining the system pressure the primary cooling fails by leakage through a pipe.

48 V Supply

A number of critical reactor con= trol, measurement and breaker operations use the 48 Volt direct current power supply (battery).

Heat Transport System Pressure Control on wide range

The enormous heat produced in the reactor needs to be expeditiously removed at all times. This is done by circulating heavy water at high pressure. High pressure is needed to prevent boiling. Heavy water at atmospheric pressure would boil off. But this enormous pressure has to be adjusted within specified limits. The range of pressure is regulated within H wide and a narrow range by separate mechanisms.

High Differential Temperature Trip

The temperature difference between the inlet and outlet arms of the primary heat transport system has to remain within a specified range. If this temperature difference becomes larger than required due to the tripping of one of the pumps, this would upset the balance between the hot and the cold legs of the system and initiate a turbine trip.

Valvlng In

To open the valves (in this case the valves of the shutdown cooling system).

by the indication provided on the shutdown cooling loop.

Meanwhile all entries to the boiler room were thwarted by the presence of thick black smoke and soot. Boiler room ventilation was shutdown to prevent possible spread of fire.

Shutdown Coding System

Two Shutdown Cooling Systems connect to the reactor inlet and outlet headers, essentially in parallel with the primary pumps and steam generators. As the reactor cools down, these systems, each with a pump and heat exchanger gradually take over decay cooling. Initially pumping force through the heat exchangers is provided by the primary pumps, but, as the coolant temperature decreases, shutdown cooling pumps assume this function and the primary pumps and steam generators are isolated.

Note: The thermosiphoning effect leading to passive cooling mentioned in the article "Near Miss at Narora" in this issue also performs the same function

Jumpering

In this case the Emergency Inejection Control System was bypassed by putting a short circuiting wire between the input and output points and the control supply was directly connected to the system which controlled the valves of the shutdown cooling system.

Incipient Degradation

In a cable joint, duo to the esrtosive effect of moisture or due to other causes, the joint slowly becomes open in small areas finally leading to a heavy arc of a huge current.

Reactor building dampers were opened to purge out the building atmosphere and also depreasurising damper was opened. At 1900 hours ventilation duct manhole cover was opened and boiler room smoke was fully purged out. At 2100 hours first proper entry into boiler room could e made and by this time fire was completely extinguished

Control **Room Staff** Handling of **the** Incident

Que to the huge fire in the boiler room, many control cables were damaged, thus making vital indications, systems and controllers unavailable. Also many safety systems got spuriously actuated and false indications/informations were flashed into the control room annunciation system.

To sift out the false indications, discard the false information and come to the right conclusion became a difficult task.

But, the availability of some vital indications despite the fire, good system knowledge and experience among the control room staff resulted in good operator response leading to the safe shutdown of the station. The availability of expert knowledge and other forms of help from the general shift, Technical Unit staff, Fuel Handling System staff and the maintenance staff present at the time of the incident was a big help.

Also the maintenance of a calm environment without panic in the control room led to the fast and correct actions being taken to mitigate the consequences of the fire.

Cause of Fire and Rehabilitation

The incipient degradation of the integrity of the 3.3 kV cable joint of heat transport pump No.2 resulted in a heavy drawal of arc which in turn ignited the fire and this spread to surrounding power and control cables, thus causing the accident. The oil deposition on the power cables in boiler room could have aggravated the situation.

All 3.3 kV and 415 V power cables totaling 250 in number damaged by the fire, were replaced and nearly 70 joints made using the Raychem technique. All control cables were terminated in 9 newly installed junction boxes. Rerouting of power and control cables were also done. This was a massive job involving site and outside agencies.

Modifications

1. Smoke detectors were installed in discharge ducts of boiler room cooling fans, to trip the fans in case of fire.
2. Spraying of fire retardant paint was done on cables in boiler room.
3. Fire barriers were constructed.
4. Tray covers were provided on top of control cable trays.
5. 3.3 kV cable joint temperature monitoring was made available.
6. Regular cleaning of cables to remove oil deposition was initiated.

Lessons Learnt

1. Fire re tardant cables to be used in future.
2. Cable joints to be avoided.
3. Installations of automat* ie fire extinguishing systems to be provided.
4. Adequate separation between power and control cables to be provided for.
5. Provision for closed circuit television surveillance of potential fire hazard areas.

Concluding Remarks

The fire incident handled was without precedent. Calm and judicious observation by experienced control room staff led to correct and rapid actions being taken to reduce the consequences of the accident and a safe station shutdown.

On the basis of this incident, *appropriate design modification are to be carried out in operating and future reactors,* **not to mention the extreme importance of the availability of trained adequate and experienced manpower for safe handling of such accidents.**

Evidently, the "lessons learnt" in 1985 at RAPS remained confined to published reports and did not result in any modifications to layout design and operating procedures at Narora. Even essential fire fighting equipment was absent. Will Narora lessons help in avoiding a future catastrophe? With the nucleocratic mindset being so impervious to self-examination, the prognosis is not good.

OOPS! We Goofed

Self Serving Antics of the International Atomic Energy **Agency**

In 1986, just after the nuclear disaster at Chernobyl, nuclear industry worldwide was in doldrums. If an accident of this magnitude could happen in Russia, it could happen anywhere. Despite all attempts at playing down the scale of the accident at Chernobyl, the industry and IAEA knew very well that the public would not tolerate an industry with a potential for causing such cxitastrophes. It was imperative to find an excuse-an extenuating circumstance demonstrating that what happened at Chernobyl was an aberration, a state of affcurs so abnormal and unrelated to nuclear operations, that it could not in any likelihood be repeated anywhere else ever again. The Soviet nuclear establishment was understandably eager to find scapegoats amongst the operating staff and shift the blame away from itself

The interest of both these powerful lobbies were thus coincidental and hence at the Vienna Conference on Nuclear Safety in August of 1986, there was a great deal of mutual bonhomie. The Western nucleoctxits went gaga over "Soviet openness", while the Soviets were full of talk of "International cooperation and solidarity" in the nuclear field. Soon afterwards International Atomic Energy Agency sent a team of 14 'experts' from 14 nations—International Nuclear Safety Advisory Group (INSAG) to study the accident in detail. INSAG presented a report (INSAG-1) which came to a number of conclusions—atnong them$_f$ that tlie accident represented "almost a worst case in terms of the risks of nuclear energy/' It went on: "As discussed in detail atnongst the experts, the accident was caused by a remarkable range of human errors and violations of operating rules in combination with specific reactor features which compounded and amplified the effects of the errors 'and led to the reactivity excursions."

One would expect that since these were ' Inter nationally Renowned Experts' giving their considered opinion after many months of deliberations and after any number of computer simulations and other such high-tech wizardry. their opinion would be of lasting value to future generations. Specially since their 'expert opinion' was instrumented in sending some operators to jail for a period of five years on charges of gtx>ss and criminal negligence. The public prosecutor cited the INSAG-1 report as proof that international experts agreed with Soviet authorities that the RBMK design was not to blame.

As the following piece so charmingly puts it, much has changed in the last seven years both politically and technically. Western nuclear industiy has survived the Chernobyl blotv, but is today desperately looking for orders for new construction of power plants and its eyes are set firmly towards tlie erstwhile Eastern Block. Its interest no longer coincides with that of the nuclear establishment in the old Soviet Union. Thus, we now have a revision of INSAG-I by another group of 'experts' of the International Atomic Energy Agency which finds the conclusions arrived after so much deliberations by INSAG-l to be erroneous and in need of 'updating'. One wonders if this is the final version of what actually transpired at Cliernobyl or whether another change in the political and economic climate would produce another updated INSAG report.

INSAG Revises Chernobyl Report

It is, it seems, in the nature of human beings to seek scapegoats. In the aftermath of a major catastrophe there is an instinctive search for an individual or individuals, to blame. In the case of Chernobyl, it was the operators. In their report—INSAG-1—tasued in September 1986, and baaed largely on Soviet evidence, the International Atomic Energy Agency's International Nuclear Safety Advisory Group (INSAG) ascribed much of the blame for the Chernobyl accident to those in control of the plant at the time.

Much has happened, politically and technically, since then. Most analyses now associate the severity of the accident with defects in the design of the control and safety rods, in conjunction with certain characteristics of the physics design which permitted the inadvertent setting up of large positive void coefficients. It has also become apparent that these deficiencies were known about in the Soviet Union before the accident, but had not been corrected.

In its recently released second report on Chernobyl, (INSAG-7 The Chernobyl Accident: Updating of INSAG-1, IAEA, Safety Series 75 1992) the Group revises INSAG-l and places a greater emphasis on design issues.

*

Beyond Vienna

The account given by the Soviets to the 1986 Vienna Conference stated that the accident arose through a low probability coincidence of a number of violations of rules and procedures by the operation staff and by those responsible for authorizing the test.

The analytical work which followed in late 1986 had the benefit of Soviet data on the control rod configuration, the power level and the spatial distribution of power just before the accident, as well as information on the thermal-hydraulic conditions that prevailed.

Some analysts found that it was difficult to match in their models the time history of the power excursion as it had been published by the Soviet scientists at the Vienna meeting. A search therefore began for an additional mechanism that might have come into play.

The existence of the positive scram effect was first acknowledged by Soviet experts at the Conference on Nuclear Power Performance and Safety in Vienna in 198T. However, the 1991 report on Chernobyl by a Commission of the USSR State Committee for the Supervision of Safety in Industry and Nuclear Power (SCSSINP) states that this phenomena had been known of at the time of the accident and that it had first been identified at the Ignalina RBMK (Chernobyl-type) nuclear power station in the Lithuanian Republic in 1983. But no oorrection was made following this discovery at Ignalina, no compensatory measures were taken and any dissemination of information to operating organisations was not followed Up.

Two earlier accidents at RBMK reactors, a fuel channel failure at Leningrad-1 in 1975 and a fuel failure at Chernobyl-1 in 1982, had already indicated major weak* nesses in the characteristics and operation of RBMK units, according to SCSSINP. The accident at Leningrad-1 is even considered by some to have been a precursor to the Chernobyl accident. However, the lessons learned from these accidents again prompted at most only very limited design modifications or improvements in operating practices. Because of lack of communication and lack of exchange of information between the different operating organisations, the opera* ting staff at Chernobyl were not aware of the nature and causes of the accident at Leningrad—1.

The most likely final event at Chernobyl seems to have been thee insertion of safety rods at a vital moment in the test, which worsened to a destructive level the conditions already prevailing. On the other hand, the RBMK design had set a number of other pitfalls for the operating staff, any of which could just as well have caused the initiating event for this or an almost identical accident, INSAG notes.

For its part, INSAG finds it difficult to say with confidence which particular weakness ultimately caused the accident, preferring to point out that a precise identification hardly matters when any of them could have done it.

Violations, or just mistakes?

Specific violations of procedures were identified in 1986 as major causes of the accident. INSAG—7 corrects the apparently false impression given about a number of them. In particular:

- The statement that there was a proscription on continuous operation of the reactor at power levels below 700 MWt was wrong- There should have been such a proscription, but there was none at the time.

. In INSAG-1 it was stated that operation with too low an Operating Reactivity Margin (GRM) was a violation of requirements. In recent deliberations, INSAG has in fact questioned the ORM concept.

It was stated in INSAG-1 that, at the time of the test, three components of reactor protection had been disabled at Chernobyl. INSAG-7 points out that disabling of the Emergency Core Cooling System (ECCS), which happened 11 hours before the accident, was not prohibited under normal procedures at Chernobyl. In fact, INSAG understands that it was a requirement of the test schedule. Disabling of the trip on the steam drum water level would have been allowable; however, it did not occur. Disabling of the "two turbines' trip was allowed, and indeed was required by normal procedures at low power levels. In any event, the occurrence of this trip might well only have caused the destruction of the reactor sooner rather than later.

In general, INSAG concludes that the accident can be said to have flowed from deficient safety culture, not only at the Chernobyl plant, but throughout the Soviet design, operating and regulatory organisations.

Andrew Cruickshank
ATOM March/April 1993

The recurrence of fires in Indian nuclear plants clearly show that the Indian design, operating and regulatory organisations are as deficient in safety culture as their counterparts in the Soviet Union at the time of Chernobyl.

When Experts Utter Unpalatable Truths Change the Experts

"Speak the truth, but speak that truth which is pleasing to the ears! is an old Sanskrut saying. Nuclear experts at Pace University in U.SA. must be feeling that it would have been better if their 'classical' education had included a course in old Sanskrut.

In the wake of Chernobyl, Pace University had been commissioned by the U.S. Department of Energy (DOE) to do a study to determine the health and environmental costs to a community of nuclear power production. However, now that these experts have found that the costs are much higher than the 'officially approved numbers', the DOE and Federal Energy Regulatory Commission (FERC) have both cried foul and have oriticized the study in rather harsh Ianguage.

What both the report's authors and critics agree on is that almost all of the external costs associated with nuclear power are associated with reactor accidents rather than normal plant operation. (They ought to read the last issue *o{Anumukti* on Rawatbhata—-Editor.) Where there is strong disagreement, however, is in estimates of the scale of costs associated with the Chernobyl accident - the benchmark upon which the report is based - and the likelihood of a similar accident occurring in the U.S.

The Pace report estimates that the likely frequency of a Chernobyl-ocale accident is 1 in 3300 reactor years. (Since there are already over a hundred reactors operating in the US for well over twenty years, they have accumulated over 2000 reactor-years of experience.) The DOE on the other hand, feels that the chance of a Chernobyl scale accident in US is less than 1 in a million reactor years—a figure 300 times lees than that arrived by Pace experts.

Long experience with sometimes recalcitrant experts have taught DOE never to have just one set of experts to do a study. Thus, it is no surprise that two other studies have simultaneously emerged from Organisation for Economic Cooperation and Development's (OECD) Nuclear Energy Agency. This OECD report puts this figure in the middle at 1 in 100,000 reactor-years. In a note included in the report, the chairman of the OECD report said that the principle reasons for the differences between the Pace and their studies was that the University analysis looks at the existing US situation rather than modern plant options (for both nuclear and fossil fuel plant).

In addition, DOE argues that by failing to take into account updated data on the radioactivity releases from Chernobyl, Pace estimates on fatalities are more than what would actually occur. Richard Ottinger, one of the Pace report's principal authors, has accused the DOE "of playing politics with science".

These studies are being conducted since the US nuclear power industry is desperately trying to revive itself by doing an integrated resource plan. The attempt is to show that everything considered nuclear power is a less environmentally harmful source of future electricity than alternative options. Following the controversy, Federal Energy Regulatory Commission has urged state regulators to postpone efforts to take on board external costs in their integrated resource planning until after a DOE/European Community study has been completed later this year.

Based on a report in
Atom March/April 1993

Another Blot on the Russian Landscape

This April, when the Western media first carried coverage of an 'accident' in a reprocessing plant at a mysterious place in Russia called Tomsk-7, we could be excused for thinking the event was no more than a minor hiccup in a decrepit weapons complex and of little or no importance for the nuclear industry worldwide.

Newspapers said that there had been an explosion in a tank 'containing an industrial uranium solution' and the event was a '3' on the International Nuclear Event Scale (INES) (Same as Narora fire) implying virtually no offsite contamination. For comparison wo ware reminded that Chernobyl waa a 6 or 7.

What we were not toia for some time was that the Tomsk-7 plant is a vast, sprawling complex, the size of Paris'. Technically, 'no offsite consequences' on a site this big are entirely consistent with hundreds of square kilometres of onsite contamination! Nor were we told that the blast took place during the reprocessing of spent nu-

clear fuel from military production reactors.

Up to 100,000 'people work at the complex, a* military 'closed city' 15 km from the oity of Tomsk' in Siberia, 2,700 km east of Moscow. Its inhabitants enjoy a relatively privileged existence, immune to the problems of price rises and unemployment that trouble other Russians. According to one report in the New Scientist, "Unlocked Mercedes stand outside houses, wages are high and the shops are full all year round with bananas and other goods unimaginable to the ordinary Russian."

By 1990, Tomsk is thought to have produced about 60 tons of plutonium using reactor fuel from Chelyabinsk. When the military production reactors at Chelyabinsk shut down in the late 1980s, the volume of spent.fuel being reprocessed at Tomsk fell considerably, but in 1991 commercial reprocessing contracts were concluded with France and South Korea.

Russia is awash with the world's largest stockpile of plutonium, estimated at 180 tons, of which 150 tons are,—or were — for military use, and is nominally committed to nuclear non-proliferation, yet it continues to reprocess and separate plutonium at Tomsk, Chelyabinsk, and Krasnoyarsk.

In January 1993, the deputy Minister for Atomic Energy, Viktor Siderenko, announced that Tomsk was to be the disposal site for plutonium from warheads destroyed under the START treaty. The idea was to make the weapons-grade plutonium into grapefruit-sized balls, then wrap each ball in boron-impregnated plastic, place them four at a time into argon-filled steel containers, then stack the containers 14 metres deep in concrete lined basins covered by massive concrete roofs, Strong enough to withstand a direct hit by a nuclear weapon*. However, the programme was officially vetoed by the Tomsk regional parliament months before the accident.

The explosion apparently occurred during an otherwise routine process late in the reprocessing cycle in which uranium and plutonium is extracted from spent fuel. This involves the addition of nitric acid and organic solvents to a solution of dissolved spent fuel. As it involves several stages, and because heat-producing chemical reactions happen when nitric acid is added to anything containing organic solvents, it has to be carefully monitored.

When government experts examined instrument records, they found that senior shift operators at Tomsk "had not monitored the concentration of nitric acid and had added too much, which had led to the explosion. As well emergency relief valves that should have opened were closed.

The explosion happened when two out of three of the extraction cycles had been completed and' large quantities of very highly radioactive fission-products already removed. It blew the top of the underground stainless steel and concrete tank in which the blast occurred, and led to a fire that burned for one and a half hours before it was extinguished.

Sources at the Tomsk plant later acknowledged that quality control there was a problem, and that at least three similar explosions had happened during the 1960s. But officials claim that safety standards were better in the past before cuts in wages and funding.

Reports about the extent of contamination from the explosion have been contradictory. A north easterly wind was blowing'at the time and Greenpeace claims Russian air force pilots picked up a plume of radiation traveling at an altitude of 3000 metres in that direction. An area of about 120 square kilometres of forest and mountain is said by another source to have been contaminated. Reports from Tomsk indicate that iodine was administered in some villages, and there was confusion and panic with people trying to flee the *city,*

Friends of the Earth UK claims the International Atomic Energy Agency has never carried out any safety inspection of Tomsk, and that it was officially notified of the explosion only 12 hours after it had heard media reports. The IAEA has no powers to inspect installations such as Tomsk-7 or Hanford, Sellafield, La Hague, Marcoule or BARC in Bombay and it has "no knowledge" of safety systems at Tomskr-7.

In the immediate aftermath of the accident, all reprocessing activities at Tomsk were halted but plant officials said the plant would go on line again 'in a few weeks'.

However, there are more far reaching consequences for the siting of the proposed plutonium storage facility. On the day of the accident, the regional parliament had rejected a motion by environmentalists to hold a public referendum on the future of the Tomsk-7 complex by a margin of five votes. The explosion has changed the political environment. The referendum is expected to be re-launched.

Chernobyl, Chelyabinsk and Tomsk are not the only household names in the nuclear lexicon of the former Soviet Union. In Voronezh, where the first Soviet nuclear power plant was built, there are reports of people stealing and drinking radioactive alcohol used for flushing out the cooling system. As a result of numerous radioactive spills, the soil in the area is almost as' contaminated as that around Chernobyl and yet Voronezh potatoes can still bebought at any market in Moscow.

Bated on *an article* by: John **Holam**
The Third Opinion Autumn 1993

Nagarjunasagar or Srikakulam
Atomic Threat Remains Potent in Andhra

Recently we received a letter forwarded by Mr Batu Sahgal, editor of The Sanctuary Asia magazine. It Was a letter from Mr Kamal Nath, Minister for Environment & Forests. At the same time we also received a letter from Ms Indira Vijaysimha-a reader from Bangalore—forwarding a letter to her from an NGO in Orissa and requesting help with regard to information regarding nuclear power plants. We publish both these letters together since they show that even after organised protest, (as happened at Nagarjunasagar) nuclear threat does not vanish. It just threatens next door.

Kama! Nath
Minister
Environment & Forests
INDIA

D.O.No. 11018113 /85-Env.5-IV
7 May 1993

Reference is invited to your letter of 16 March, 1993 conveying your concern for the proposal to set up a Nuclear Power Plant at Nagarjunasagar which happens to be a Tiger Reserve.

I may inform you that the Ministry of Environment & Forests has not approved the site.

Kamal Nath

Samman
Bhimsagiri, Dist: Ganjam 761066
Orissa

You must be aware that the Government of India is planning to set up a nuclear power plant, reportedly for power generation at Ranasthalam in the Srikakulam district of Andhra Pradesh. Radiation from the plant, we have been told will affect the human population and the environment in a radius of 170 km.

Unfortunately, we are woefully short of information regarding nuclear power plants. Could people involved in the antinuclear struggles elsewhere send *US* material that would be relevant to our situation? We would also like to network with other antinuclear groups within the country.

Ungia Panda

The Coming Battle

Orissa, the theater for some powerful people's movements in recent times, is gearing itself up to wage another significant one on the southern-most fringes of the state.

The proposal to put up two nuclear reactors of 500 MW capacity each at Ranasthalam in Srikakulam district, will pose grave danger to life and environment of a vast area in Orissa and Andhra. The major towns lying within a radius of 100 miles of the proposed site, include Viaakhapatnam, Vizianagaram, Berhampur, Jeypore, Rayagada, Koraput, Anakapalli, Tuni, Parlakhemundi and Gunpur. Apart from these towns, significantly, the eco-eenaitive Mahendragiri biosphere falling in both the states would be directly affected by radioactive pollution.

Many people and organisations have decided to oppose the project. Samman, a Berhampur based voluntary organisation in Orissa engaged in safeguarding the eco-system of Mahendragiri-Kerandimal mountain range and COPDANET (Coastal Poor Development Action Network) in Andhra Pradesh have taken the lead in spearheading the opposition.

Plans have been already drawn up for a mass awareness campaign and a padayatra through the region likely to be affected by the proposed plant. What is agitating the people of the area most is the prospect of a total devastation of the fragile Mahendragiri forests already ravaged over the years by rapacious timber merchants and shifting cultivation. The climate of this region is governed by the Mahendragiri forest reserve-home to some of the rarest species of orchids and having a bio-diversity of bewildering variety.

While the specter of a Chernobyl kind of nuclear disaster is fresh in the minds of the people what causes more alarm is the radiation hazards which are routine in normal operation of a nuclear reactor. Another cause for real concern is the large amount of radioactive wastes generated by the plant According to T. Shivaji Rao. emeritus in environmental engineering of Andhra University, Waltair, the notion of safety dose propagated by Department of Atomic Energy is a "myth". The activists in Andhra as well as Orissa have been using Shivaji Rao's study on the hazards of nuclear plant as the manifesto for their movement. Supporting Rao's contention they have been demanding the right to information and decision- making for the people under Article 48(A) and 61(A) of the Constitution.

The opponents of the Ranasthalam nuclear power plant have another significant objection. Such projects of 'development', only help the rich and the strong. The only real beneficiaries of such plants are contractors, suppliers, the politicians and the officials."

Srimoy kar
Indian *Express* February 6 1993

Sources of Contamination of RAPS Workers

I refer to Rawatbnata (Special Issue, Anumukti, Vol 6. No.5, April/May 1993). The value of your excellent study would have been greatly enhanced if you had included very important data on the functioning of the Rajasthan Atomic Power Plant since its inception. There have been various design, operational and maintenance shortcomings which could have resulted in greatly enhanced radiation exposure to workers and public alike. These are documented in a publication entitled *Third National Symposium on Operating Experience of Nuclear Reactor* and Pouter Planls (198)* brought out by Bhabha Atomic Research Centre and the Department of Atomic Energy. I list a few of these instances bordering on criminal negligence and irresponsibility.

Enormous fuel failure rates went unchecked for many years.

Because'of a lack of confidence in their own instruments for an unspecified number of years, RAPS authorities disregarded indications of fuel failures. This, by their own admission resulted in greatly enhanced exposure to workers and the public.

Workers had to frequently enter restricted areas while reactor was on-power, because of frequent breakdown of the adjuster rod control mechanism.

Exposure to heavy radiation of workers due to faulty pressure relief devices.

There are blow-out panels at various locations in a pressurised heavy water reactor used for relieving pressure. (Much like a safety valve in a pressure cooker-Editor.) This blow-out panel is sealed with an adhesive tape at RAPS. **The sealing effect is lost after sometime as the tape unglues. This results in a release to the atmosphere of tritiated heavy water. Workers in the area are exposed to radiation due to this tritium. Since the adhesive tape requires frequent replacement, this activity too exposes workers to additional radiation.**

- Seventeen categories of major incidents involving on-line fueling machine have been described in an article by Mr Dileep Bhatia in the reference cited above. These involved manual handling of irradiated fuel bundles. These fueling machine failures also involved several station shutdowns.

- The notorious south end shield which protected workers from heavy radiation cracked in 1981 and tenaciously refused to be effectively plugged. Attempts to repair this shield resulted in additional cracks. Despite the vehement assurances of Mr S. L. Kati that you have quoted in your paper, the years spent in trying to rectify this problem did. result in heavy radiation doses.

No wonder your data about the proximate villages reveals the horrifying extent of the multidimensional tragedy.

R. Ashok Kumar. Negentropist
Bombay Sarvodaya Mandol
Bombay

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